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THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

World Class U.S. Shipbuilding Standards

Task 2: The Management Plan

Part 2: Trip Report to SHI Shipyard, Hokosuka, Japan

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

in cooperation with
National Steel and Shipbuilding Company
San Diego, California

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April 17, 1996

O. HIRAHAMA
Manager, Basic Design Group
Sumitomo-Heavy Industries, Ltd.
19, Natsushima-Cho
Yokosuka 237, Japan

Dear HIRAHAMA san,

Enclosed is our final Trip Report report, (incorporating your comments), of our visit with your shipyard. These report replaces your copy of the Draft Trip Report. The discussions and information provided on your World Class Shipbuilding Standards development and management program was constructive and informative.

Again, on behalf of all team members, I wish to thank you and all of the people at SHI for your quality time and thorough coverage of the standards of the questions that we asked. Your hospitality was appreciated very much.

All of the team members look forward to seeing you, should opportunity present itself, at future functions involving the World Shipbuilding Community.

Sincerely,

Devens D. Arnett
Director of Engineering

TRIP REPORT

NSRP STANDARDS TEAM VISIT

TO

SHI SHIPYARD

YOKOSUKA, JAPAN

DECEMBER 4-7, 1995

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22 December, 1995
Revised 22 March 1996

TRIP REPORT

Subj Trip Report, NSRP Standards Team Visit to Sumitomo Heavy Industries Co., Ltd. (SHI) Shipbuilding Division, Yokosuka, Japan - 11/26-12/9/95

Encl (1) IHI Co., Ltd. - Trip Notes
(2) Aerial Photos of SHI's Oppama & Uraga Shipyards and SHI Profile
(3) Ship Design CAD Systems and Planning Systems
(4) NSRP SP6 Project 6-94-1, World Class Shipbuilding Standards, Questions and Response from SHI's New Construction Oppama Shipyard, Yokosuka, Japan - dtd 12/22/95

Traveled to Tokyo, Japan on 25-26 November, 1995, to meet with other United States Shipbuilders' representatives to visit Ishikawajima-Harima Heavy Industries Co., Ltd. Shipbuilding Division, (IHI), and Sumitomo Heavy Industries, Ltd. Shipbuilding Division, (SHI), to learn about their development and application of standards to the commercial shipbuilding process.

Team Members:

Phil Lloyd	NASSCO
Walter Devine	NASSCO
Bobby Joe Griffin	Avondale Shipyard
Laddie Matherne	McDermott Shipbuilders
Raphael Cronin	NNS
Devens Arnett	CDI Marine Co

The team has endeavored to present the highlights of what we learned at SHI in this trip report summary. Enclosures (1) through (4) provide further details.

<u>About SHI's Ship Group Oppama and Uraga Shipyards and SHI</u>
SHI started its shipbuilding in 1897 at the Uraga Shipyard, and established the new Oppama shipyard in 1971 - one of Japan's oldest and one of Japan's most modern. The Uraga shipyard is located approximately 5 miles south of the Oppama shipyard, at the mouth of Tokyo Bay - the Oppama shipyard is located in Yokosuka City. Oppama concentrates on commercial shipbuilding while Uraga performs design and construction of Japanese naval vessels. The design for navy and commercial work is kept separate. SHI will move production personnel between the two shipyards to maintain a level workforce.

SHI is a large corporation having 6 major divisions and covering a multitude of diverse applications - such as: industrial machinery, iron and steel manufacturing, material handling equipment, water and waste treatment plants, chemical processing and nuclear power plants, etc.. Refer to Enclosure (2) for aerial shipyard photographs, shipyard layout graphics and other informative publications of SHI's profile and history.

Since its inauguration, over 95 years ago, SHI has constructed approximately 1200 vessels including tankers, combination carriers, bulk carriers, ferry boats, dredgers, pure car carriers, sailing ships, passenger ships, work ships, crane barges, naval ships and etc.. The Oppama Shipyard is currently building 2 VLCC's, 2 bulk carriers, 2 crane barges, and an offshore platform. A partial listing of typical construction commitments - vessel type, tonnage, governing classification societies, start construction and delivery dates, as of 1994, are shown in Attachment (1). Also provided in Attachment (1), is a listing of ships constructed over a four year period ending November, 1993

There are less than 1000 production workers in both yards - including bridge work and "in yard subcontractors"; 300 designers and administration people and $\leq$ 2000 total production workers, designers, administrators, and subcontractors (in house and outside). SHI employees are assured lifetime employment; all have a desk at which to eat lunch, and to think and to write suggestions for improvements and efficiencies to construction processes, standards and methods.

The Japanese Government restricts the number of shipyards that are allowed to build VLCC's - currently at 8 - and the Oppama Shipyard is one of the selected shipyards. Japan's Ministry of Transportation (MOT) sets the rules. The MOT also limits the maximum CGT of ships that a builder can contract - even if the builder has the capacity to build the larger vessels. The relaxing of the restrictions on size is under discussion with the MOT. This is considered necessary because Korean yards are significantly expanding their capacity. Presently, SHI has 2-3% of the world market for tonnage and < 10% of the VLCC market. Japan's total shipbuilding market share is 42%.

<u>Discussion</u>
SHI's Senior Management provided quality time to review SHI's profile and respond to our questions as well as arranging for many of the shipyard's managers from Design and Quality Assurance areas to participate in the discussions. The principal participants were:

<u>Oppama Shipyard</u>
Mr. Takaji Nakanishi, Managing Director, General Manager, Ship Group and General Manager , Aerospace Dept.
Mr. T. Itoh, General Manager, R&D and Basic Design Group

Mr. O. Hirahama, Manager, Research and Planning, Manager, Basic Design Group, etc.
Mr. T. Takiguchi, CIM Project, Design Department
Mr. K. Shin, Group Manager, Electric Fitting Design Group
Mr. K. Osaka, Manager, Machinery Fitting Design Group
Mr. Y. Yamaguchi, Manager. Quality Assurance Dept.
Mr. H. Suzuki, CIM Development Group, Design Dept.
Mr. A. Terada, Manager, Purchasing Group and Planning & Control Group
Mr. S. Kawachi, Senior Engineer, Overseas Procurement, Design Dept.
Mr. M. Iijima, Manager, Hull Structure Design Group
ABS Pacific
Mr. Ken OKABAYASHI, Manager-Japan

SHI's Standards were established a long time ago and are well integrated with their design and manufacturing processes. SHI standards are identified as SHS for Hull, SKU for Outfitting, and Construction Standards for the shops [basically, Japanese Shipbuilding Quality Standards (JSQS) - refer to Attachment (A)]. SHI's Standards are controlled by many groups within the technical disciplines and QA. All standards are maintained by the people who use them. SHI has over 10,000 SHS, SKU and Construction Standards. A typical standards representation in a diagram booklet is shown in Attachment (B).

Their present Standards exist in a paper base format, but are being incorporated in an CAD data base, to the extent required to support a fully automated CAD/CAM process. SHI orders material by their standards number- (serves as a parts catalog also).

SHI top management is encouraging standardization among Japanese shipyards to use the same type equipment, in an effort to lower costs.

SHI and IHI are working jointly on a the development of a CAD/CAM system that is common to both facilities, in an effort to keep development and maintenance costs down. Individual yards will develop CAD/CAM systems further to meet individual yard preferences and practices. In order to achieve maximum benefit of CAD systems, SHI also anticipates some equipment type standards will have to be standardized between yards (IHI/SHI).

SHI has more than 10 CAD Engineering Work Stations and is adding ~ 3/year. Would like to shift from PC's to Engineering Work Stations. Hull piping design uses 3D models. An automatic electronic transfer of material requirements from the 3D model, to the PC based material ordering documents, does not currently exist - this is done by manual listing of the requirements from the model and entering the information into a PC. SHI design is working towards full adaptation and implementation of CAD in the Machinery Fitting Design Group with emphasis in the machinery space piping area.

Currently, piping and ventilation systems design are done manually for arrangement machinery space and by 3D CAD on a 2D hull background for all deck piping. fabrication information is lifted manually from the manual drawings and provided in list format from 3D CAD drawings. This information is used to enter cut and bend data into a host computer for NC fabrication. Their information flow and Design Development Information is shown in Attachment (C).

SHI has been ISO 9001 certified for Hull Structure since 1993 and intends to get Outfit Design certified in the future. Most Japanese companies are moving towards some level of ISO 9000 certification to remain competitive in the world market. (Mr. Ken Okabayashi, Manager, ABS Japan, believes that within 3 years - most Japanese shipyards will have some level of certification.)

Other areas of interest and information provided include the application of internal poly coating/liner for steel pipe used in corrosive systems - refer to Attachment (D). An example of a Contract Specification Index, with representative sections, for a VLCC was also provided - refer to Attachment (E).

<u>Summary</u>
Standards utilization at SHI is a vital to ship production efficiencies. They are very much second nature and integrated into all phases of the shipbuilding process. SHI's customers are generally well aware of the extent and quality of these standards and do not have this as a major concern when contracting for a new vessel or structure.

SHI is a well established World Class Shipbuilder of vessels of distinction. They closely follow the world shipbuilding capabilities and practices to ensure they are always abreast of the technology. In a true spirit of cooperation, as mentioned earlier, they are working with IHI, and sharing associated CAD/CAM development costs, to achieve 100% CAD/CAM capability. It is evident that SHI is working diligently to ensure that the shipyards of Japan continue to be the leaders in the Global Commercial Shipbuilding Market in the future.

ENCLOSURE (1)

- **SHI Visit Trip Notes**

12/22/95
Revised 3/22/96

SUMITOMO HEAVY INDUSTRIES, Ltd
OPPAMA SHIPYARD VISIT - TRIP NOTES

(*Indicates information duplicated in formal Trip Report, file: shitrip.doc)

Attachment (A) Japanese Shipbuilding Quality Standards (JSQS) - Examples of
(B) Representation of Standards Used, Excerpt from Diagram Booklet
(C) Steel Pipe Poly Coating Application - Pictorial Process Flow
(D) Typical Information Flow and Design Development - Hull and Outfitting Depts.
(E) Contract Specification Index and Representative Sections for VLCC

MONDAY 4 DECEMBER, 1995 - OPPAMA SHIPYARD

Mr. O. Hirahama, has multiple responsibilities -Project Manager of VLCC, Naval Architect Manager, Research and Planning dept., and etc.. Also present: Mr. T. Itoh, General Manager R & D Basic Design Dept. Ship Group and Manager of The Design Dept. and Mr. T. Takiguchi, Manager CIM Project (CAD/CAM) Design Dept. Ship Group

* • Welcome to Sumitomo Heavy Industries, Ltd Shipyard. Sumitomo started its shipbuilding in 1896 at the Uraga Shipyard and in December 1971, opened the Oppama Shipyard to build "distinctive and ultra-large ships to the highest up-to-date technical standards".
* • SHI is currently building 2 VLCC's, 2 bulk carriers, 2 crane barges, and an offshore platform. A partial listing of construction commitments - vessel type, tonnage, governing classification societies, start construction and delivery dates - as of 1994, are shown in Attachment (1) [to Enclosure (4)]. Also provided in Attachment (1), is a listing of ships constructed over a four year period ending November, 1993.
  • Viewed a video [made 8/25/93] of the Eagle, Double Hull VLCC Mobile Tanker. 317m length, 58m width, 31.4m draft, 458 DWT.
    - ⇒ 6/5/92 start construction at SHI Oppama Yard. Maiden voyage 8/25/93.
    - ⇒ 2 - 300 ton Goliath cranes
    - ⇒ Dynamic Load Analysis (DLA) used for detailed assessment of hull strengths for all possible sea states.
    - ⇒ NC plasma cutting utilized extensively.
    - ⇒ Redesigned facility for double hull construction.
    - ⇒ Heavy use of robotics welding - all stages.

12/22/95
Revised 3/22/96

SUMITOMO HEAVY INDUSTRIES, Ltd
OPPAMA SHIPYARD VISIT - TRIP NOTES

* • There are less than 1000 production workers in both yards - including bridge work and "in yard subcontractors"; 300 designers and administration people and ≤ 2000 total production workers, designers, administrators, and subcontractors (in house and outside).
  • Most SHI Standards are acceptable to all customers.
  • USCG regulations are more subject to change than are other regulatory agencies. SHI adds 3 months to contracts for US flagged ships, to deal with USCG and demonstrate compliance of their standards and purchased equipment with USCG Regulations.
* • Basically, all SHI employees are assured lifetime employment. All have a desk at which to eat lunch, and to think and write suggestions for improvements and efficiencies to construction standards and methods.
* • Shipbuilding was expanding up to 1975. Japanese Government allows only 8 shipyards to build VLCC's. Government also limits the maximum beam of ships that a builder can contract - even if the builder has capacity to build. SHI believes Government may relax restrictions on size; this being necessary because Korean yards are significantly expanding their capacity. Japan's Ministry of Transportation (MOT) sets rules.
  • Not likely to enter into the cruise ship arena as Japan's prices would not be competitive for the outfit areas and the demand does not exist.
* • SHI has 2-3% of the world market for tonnage. < 10% of the VLCC market. Total market share is 42% for Japan's shipyards.
  • Total Japanese shipbuilding industry employees ~ 40K people (building 42% of the world tonnage!). [Can't compare merchant shipbuilding with naval combatants.]
  • No special preference to Classification Society choice - is a customer decision.
  • SHI influence to JIS takes about 2 years to effect. MOT largely involved. SHI personnel are sometimes on JIS committees.
* • SHI standards - SKU for fittings, SHS for hull and Construction Standards for shops. Japanese Shipbuilding Quality Standards, (JSQS) - refer to Attachment (A) - are the principal construction standards used by the shipyard. Standards are controlled by many groups (i.e., within the technical discipline) not by one major group. SHI has over 10,000 SHS, SKU and construction standards.
  • Painting standard has photographs to represent accept/reject standards.
  • Diagrams "booklets" show representative details of applicable standards - refer to Attachment (B). Detail drawings cover all areas of standard applicable to drawing content.

SUMITOMO HEAVY INDUSTRIES, Ltd
OPPAMA SHIPYARD VISIT - TRIP NOTES

- **Design at SHI based principally on JIS unless customer requests otherwise. They have to be continuously aware that USCG may change the rules. (Must show "equivalency" on a case by case basis for each JIS standard.)**
- **Input to standards includes procurement and vendors, on a case basis.**
- **8 years ago, SHI reviewed all SKU standards.**
- **SHI top management is encouraging standardization among Japanese shipyards to use the same equipment to lower costs.**
- **SHI sends representatives to working groups of ISO.**
- **SHI orders material by their standards number- (serves as a parts catalog also).**
- **Hull piping design uses 3D models. Electronic material link non existent - requires manual lift).**
- **SHI's CAD/CAM system is progressing using state of the art equipment and software, but is not currently integrated. They plan to tie CAD and CAM systems together in the near future.**
- **SHI Oppama has a large bridge building capacity. They also build tunnel drilling machinery.**

TUESDAY DECEMBER 5, 1995

Mr. O. Hirahama presiding

- **560 ton maximum lift capacity - using both bridge cranes on a balanced load. This presently is a limiting factor on the extent of outfitting.**
- **Steel piping used in sea water and other corrosive fluid applications are poly lined. SHI has used this process for many years and stated that the poly coating holds up well - upwards of 20 years or more. Refer to Attachment (C) for a pictorial process flow chart - translation not provided. Glass Reinforced Fiber (GRF) pipe is recently being used in tanks, at owners request.**
- **SHI has more than 10 CAD Engineering Work Stations and is adding ~ 3/year. Would like to shift from PC's to Engineering Work Stations.**
- **Sub contractors do some detail design - ex., deck house arrangement drawings, diagrams and joiner plans are provided by SHI. Subcontractor will do all detail design and production drawings.**
- **~ 15 subcontractors are located in house - working on CADAM System and uploading to PC, (if applicable), when completed - such as NC data. Other subcontractors are located outside the shipyard. Many are retired SHI designers.**

SUMITOMO HEAVY INDUSTRIES, Ltd
OPPAMA SHIPYARD VISIT - TRIP NOTES

- **Budget hours are transferred from production to purchasing when subcontracting is stipulated or elected.**
- **SWBS is not used. They do use a simple breakdown approach that segregates machinery, hull, general and electric - 3 levels at SHI. Very simple and basic approach.**
- **Steel sheet number is derived from the drawing that applies and is tracked by schedule.**
- **Subcontractors doing detail design must provide routing to SHI. SHI will approve and incorporate penetrations into NC data base. (Production Design will enter small pipe holes onto NC tape - they are not shown on the drawings.)**
- **Design interference checks are done manually at completion of discipline detail design drawing completion.**
- **Why did SHI go to ISO 9000?**
  - ⇒ **Prospective buyer survey was mixed - 1/2 yes and 1/2 no.**
  - ⇒ **Recommended by evaluation team.**
  - ⇒ **To provide a QA level that is common/available to all customers.**
- **Major Japanese shipyards followed United States shipbuilding approach 40 years ago in the development of their standards. (The situation is now reversed)**
- **SHI has been ISO 9001 certified for Hull Structure since 1993 and intends to get Outfit Design certified in the future. Most Japanese companies are moving towards some level of ISO 9000 certification to remain competitive in the world market. (Mr. Ken Okabayashi, Manager, ABS Japan, believes that within 3 years - most Japanese shipyards will have some level of certification.)**

Mr. M. Iijima, Manager Hull Structure Design Group

- **Information Flow and Design Development for the Hull Structure Design Group and Drawing Flow in the Machinery Fitting Design Group are shown in Attachment (D).**
- **Frequently used SHS standards are in CAD data base.**
- **Designers record all corrections to standards for each ship and these are used to formally correct master. This practice has been going on for last 5-10 years.**
- **SHI has standards volumes labeled with green ISO 9001 stickers to indicate manual must be updated to satisfy established requirements.**
- **Experience level is in two bands - 30+ years and <10 years. SHI working to transfer the 30+ years of shipbuilding to the next generation of shipbuilders.**

SUMITOMO HEAVY INDUSTRIES, Ltd
OPPAMA SHIPYARD VISIT - TRIP NOTES

Mr. K. Osaka, Manager, Machinery Fitting Design Group

- **SHI has 3 highly skilled machinery outfit engineers who have many methods of design "in their heads" that is not formally documented. SHI knows they have to get all manuals updated to show this knowledge and to permit lesser experienced engineers to continue in the future.**
- **SHI design is working towards full adaptation/implementation of CAD in the Machinery Fitting Design Group with emphasis in the machinery space piping area.**
- **2-3 people are capable of total design for machinery space piping of small vessels.**
- **Minimal personnel required to design machinery space piping due to high experience levels - 8 to 10 people.**

Mr. K. Shin, Group Manager, Electric Fitting Design Group

- **24 members in group**
- **Responsible for specification issue for all electrical equipment - cables to generators.**
- **Group writes test procedures for electrical equipment.**
- **In case of subcontracting deckhouse, SHI would provide all details for wireways and material.**
- **Has planning group - 5 people.**

WEDNESDAY, 6 DECEMBER, 1995

Mr. H. Suzuki, Manager, CIM Development Group

- **CAD System Outline - SHI and IHI are working jointly to develop CAD/CAM system development that is common to both facilities in an effort to keep development and maintenance costs down. Individual yards will develop CAD/CAM systems further to meet individual yard preferences and practices.**
- **Hull structure design support system is 2D CADAM - calculates Class rules, longitudinal strength, section modulus and rudder calculations. It is not linked to any CAM data base.**
- **Usually uses 2D CADAM System for drawings - provides all details for block assembly. Some piping outfit drawings developed in 3D overlaid on 2D structure for finished drawing.**
- **SHI has 5 NC cutting machines for nested parts in plates. Lazier cutting used for bridgework only - at this time. [Plasma cutting is 2-3 times faster than lazier cutting.]**

SUMITOMO HEAVY INDUSTRIES, Ltd
OPPAMA SHIPYARD VISIT - TRIP NOTES

- Information for cutting/nesting is transferred to cutting machine from CAM disk - not electronically linked at this time.
- No automatic marking of plates/parts at this time.
- Machinery space piping design still extensively done manually as highly experienced personnel are not computer literate.
- CAD/CAM Outfit design still under development.
- In order to achieve maximum benefit of CAD systems, SHI anticipates some standards will have to be standardized between yards (IHI/SHI).
- Believes yard layout vital to yards competitiveness.
- Currently, piping and ventilation systems design are done manually for machinery space arrangement and by 3D CAD on a 2D hull background for all deck piping. Fabrication information is lifted manually from the manual drawings and provided in list format from 3D CAD drawings. This information is used to enter cut and bend data into a host computer for NC fabrication.
- All spools for pipe and vent fabrication are sketched manually at the present time.

Mr. Y. Yamaguchi, Manager, QA

- SHI has own quality hull standard but it basically follows the Japanese Shipbuilding Quality Standard (JSQS). Refer to Attachment (A).
- All ABS Inspectors have been given copies of JSQS for "guidance".
- Inspection of units employs use of different colored chalk to identify source of quality deficiency. White - welding supervisor; yellow - foreman; Red - QA, surveyors and Owner's Rep.
- Almost all Classification Societies have accepted JSQS hull and outfit standards for QA (except US and China).
- Manufacturer's standards inspection book developed in 1971 by most of Japan's shipyards and all major Japanese shipyards. All yards have input - however, document basically same as originally issued!
- Eliminates procurement from having to specify other than by reference as all Japanese manufacturers have copies.

Mr. S. Kawachi, Senior Engineer, Overseas Procurement

- US needs to conform to metric system to become competitive in the world market. All manufacturers world wide will provide equipment with metric flanges. When Japanese shipbuilders request metric flanges on equipment, US manufacturers say no.
- European manufacturers frequently visit, (once per year minimum), major shipbuilders in Japan and Korea. The US does not.

SUMITOMO HEAVY INDUSTRIES, Ltd
OPPAMA SHIPYARD VISIT - TRIP NOTES

- **Japanese vendors want to be listed in JIS for "Type Approved" equipment.**
- **Equipment selection follows contract signing approximately within 3 months.**
- **An index for a typical vessel Contract Specification and representative sections of the contract were provided. Refer to Attachment (E).**
- **When contracting major equipment for commercial ships with Japanese vendors, initial specifications are not the final but sufficient for manufacturer to begin preparations/manufacture. Later on, final specs are written - contract cost adjustment may occur. US vendors, based on current practices, will not start manufacture until a contract is signed.**
- **SHI has 20 people in procurement (includes subcontractor monitoring). Raw material purchased by SHI Headquarters.**
- **Purchasing electronically linked to overseas procurement offices. Local procurement accomplished by manual paperwork preparation.**
- **SHI looking for a source of built up beams. US steel much cheaper than Japanese steel. Transportation costs within Japan are extremely high - believe they can import from US at a lower rate. (Inquired if interest existed in US to fabricate built up beams for their shipyard.)**
- **Vendor Furnished Information not readily available from US manufacturers.**

ATTACHMENT (A)

- **Japanese Shipbuilding Quality Standards (JSQS) - Hull Part Excerpt**
- **Japanese Shipbuilding Quality Standards (JSQS) - Outfitting Part Excerpt**

JAPANESE SHIPBUILDING QUALITY STANDARD

(J.S.Q.S.)

(HULL PART)

EXCERPT ONLY

1991

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PREFACE

As for our steel ship building practice which has been in great progress for the ten years after the end of the War, publication was already made by the sub-committee of Research Committee on Steel Shipbuilding, the Society of Naval Architect of Japan, in the title of "Steel Shipbuilding Practice", which consists of six volumes.

Since then, it has been fully realized that it is indispensable to provide a technical standard of high reliability which is to be supported by incessant examination of practice and theory with a view to maintain quality in the highest. Consequently, through a series of deliberating conferences consist of ship builders, classification societies and professors of universities, this standard of the quality of hull has been completed.

As this booklet is intended m. ly for shipbuilding practice and accuracy of products, this is tit. " Japan Shipbuilding Quality Standard" (J.S.Q.S.).

With regard to the standard of welding quality, it is excluded from this standard with an understanding to use "Standard of Quantitative Inspection and Control for Hull Appearance" published by the Japan Welding Society, Shipbuilding Division, Welding Subcommittee.

As a matter of course, these kinds of standard should be incessantly tested for their availability with ever changing technical innovation and be altered accordingly and in fact it is expected that commentary on each article shall be added supplementarily to the 1965 edition.

This standard, we heartily expect, would contribute as a guidance toward Japanese shipbuilding practice and would play an important role in producing further progress in this field.

Finally, it is acknowledged with gratitude to every member of the committee who cooperated and endeavoured in bringing the standard to completion.

Dec, 1966

Hiroshi Kihara
Chairman,
Professor, Univesrity of Tokyo

INTRODUCTION

With quality contorl being widely spread in shipyards, the aim of hull quality control has been shifted from howto deal with inspection by ship owners and classification societies to how to prevent, in advance, low accuracy in workmanship occuring in the process of construction, and the emphasis is put on the view point of securing specified quality at every stage of construction. Generally speaking, there has been variance to some extent in the accuracy of workmanship and products, and it is principle of quality control to recognize such variance to a certain extent as a premiss of quality control.

The present society's rules and regulations provide for restrictions in the details on the designing and workmanship, however, nothing is mentioned about tolerance of workmanship which mostly comes into question in practice. In view of the foregoing and in order to obtain an understanding of ship owners and classification societies, this booklet is provided and indicates the extent of accuracy to be kept in the process of hull construction and the finished quality of hull obtained as a result of quality control kept in every process of construction.

The indication given to each process of construction in order to achieve satisfactory quality to ship owners and classification societies in final is called "standard range" but even if beyond this standard range, in the case where the product does not require any correction in the following stage nor spoil the finished quality, it is called "tolerance limits". In other words, the tolerance limits is inclusive of some allowance for standard range for quality control. This value of limitation is to be theoretically acceptable and simultaneously to be practical as being available for the present situation of quality control.

According to observation, referring to ships ever built in Japanese shipbuilding industry, on the standard range and tolerance limits for each items as indicated in this booklet, the standard range occupies 95 % in probability and less 0.3 % only is beyond tolerance limits. It is believed that this would be accepted by ship owners and classification societies at least as a fact of experience.

With the way of thinking as stated above, this booklet introduces, standard range and tolerance limits for each process such as material, moulding, marking and cutting, fabrication material, assembly block, securing ship's form,drilling, distortion, and others.

It is, however, to be reminded as explained in the INTRODUCTION that the contents of this booklet shall be subject to additions and alterations in future with developement of shipbuilding practice.

Revision made in the 1985 edition

Revision has been made for lineheating of "fabrication" and short bead, tack welding bead, repair welding bead and arc strike of "welding", concerned with 50kg class higher tensile steel of Thermo-Mechanical Control Process (TMCP).
In addition, incomprehensive expressions, figures and clerical errors have been corected.

1. Marking
   1) Figure has been added to the item "Corner angle" of snb-section "General members".
2. Gas cutting
   1) "Notch is defined as groove of more than three times of roughness" has been added to the remarks of section "Notch".
3. Fabrication
   1) Figure etc. of section "flanged longi., Flanged bracket" has been corrected.
   2) TMCP 50kg HT has been added to the section "Line heating method".
4. Welding
   1) Section "short bead, tack welding bead, repair welding bead" is amended to "short bead" and subsection has been separated into "tack welding bead, repairing of scar" and "repairing of welding bead" and TMCP type 50kg HT has been added.
   2) TMCP 50kg HT has been added to the section "Arc Strike".
   3) Section "Pre-heating" has been added and sub-section "Temperature required pre-heating" for mild steel, 50kg HT, cast steel and TMCP type 50kg HT has been decided.
5. Alignment and Finishing
   1) "In case of beads are parallel" has been added to sub-section "Butt weld to fillet weld" of section "Minimum distance of weld to adjacent weld".
   2) Butt weld to adjacent re-turn fillet weld of the section "Minimum distance of weld to adjacent weld" has been separated into "Main structure", and "other structure". and tolerable limits has been fixed.
   3) "Backing strip" in the remarks of sub-section "Gap before welding" are amended to "Backing material".
   4) "CO_2 one-side welding" has been added to sub-section "Gap before welding".
   5) "Lifting eye pieces concerned with fatigue strength

to be removed" has been added to the remarks of section "Lifting eye piece".

6) Sub-section "Scar" has been added to the section "Surface defect" and tolerable limits has been fixed by depth and lengh of scar.

5. Deformation

1) "Deviation of frame" has been added to the section.

6. Miscellaneous

1) "Shop primer can be applied" has been added to painting range of sub-section "Sub-assembly & assembly welded joints".

Revision made in the 1991 edition

In this edition, following revisions have been made in the sections "GAS CUTTING", "ALIGNMENT AND FINISHING" and "RIVETING" considering the spread of automatic welding.

1. GAS CUTTING

"Depth of groove" in sub-section is to be renamed as "Depth of edge preparation" because edge cutting is not for the welding groove only.

And "Angle of edge preparation" is to be added in sub-section.

2. ALIGNMENT AND FINISHING

In sub-section "Gap before welding", item "electro gas welding" and item "simplified electro gas welding" are to be added.

As for the standard range, ordinary amount of gap decided in many shipyards is adopted.

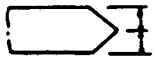
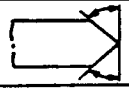
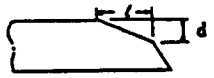
As for the Tolerance limits, the maximum amount of gap which has been used at several shipyards is adopted.

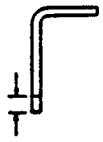
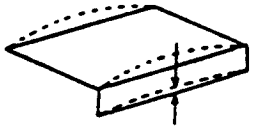
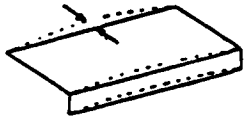
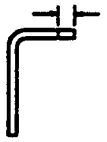
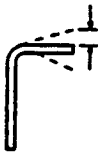
3. RIVETING

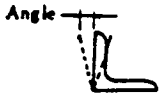
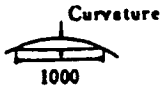
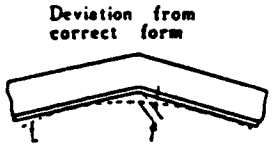
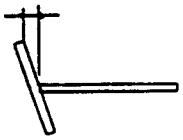
Recently built welded ships don't need this item.

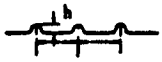
So this item to be eliminated.

In case of repair, ship which needs riveting, J.S.Q.S. (1985) is to be referred.

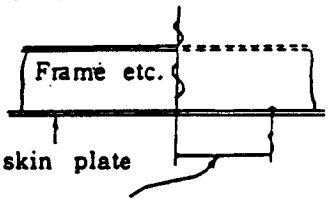
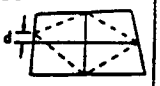
Division		Gas Cutting			UNIT : mm or (Degree)
Section	Subsection	Item	Standard range	Tolerance limits	Remarks
Notch	Free edge	1) Upperedge of sheer strake. 2) Strength deck between 0.6L ※ and free edge of opening of shell plate. 3) Main longl strength member.		Nil	In case where it is necessary to be smoothly finished by grinder, it is to be welded up. (carefully avoid short bead) "Notch is defined as groove of more than three times of roughness."
		Longitudinal and Transverse strength members.		Indentation ≦1	
		Others		Indentation ≦3	
	Weld groove	Butt Weld: Shell plate and Upperdeck between 0.6L ※		Indentation ≦2	Notch is to be repaired by grinder or gouging. (carefully avoid weld defects)
		Butt Weld: Others		Indentation ≦3	
		Fillet Weld		Indentation ≦3	
	An indentation is defined as the notch, in case where its depth is more than 3 times the tolerance limits of roughness.				
Dimension	Straightness of plate edge	Both side submarged arc welding	±0.4	±0.5	
		Manual welding Semi automatic welding	±1.0	±2.5	
	Depth of edge preparation		±1.5	±2.0	
	Angle of edge preparation		±2°	±4°	
	Length of taper	 (ℓ compared with correct sizes.)	±0.5d	±1.0d	
	Size of member	General members Compared with correct sizes.	±3.5	±5.0	
		Especially for the depth of floor and girder of double bottom compared with correct sizes.	±2.5	±4.0	
		Breadth of face bar, compared with correct size.	±2.0	−3.0 ~ +4.0	
	Edge preparation.	Automatic welding	±2°	±4°	
		Semi automatic and manual welding	±2°	±4°	

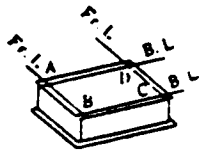
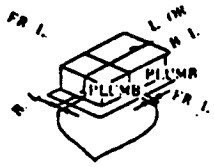
Division		Fabrication			UNIT : mm
Section	Subsection	Item	Standard range	Tolerance limits	Remarks
Flanged Longi.	Breadth of flange	 Compared with correct size	±3.0	±5.0	
	Depth of web	 Compared with correct size	±3.0	±5.0	
			±2.0	±3.0	The bracketed ones show the case where strength is especially required, e. g. longitudinal members, etc.
	Angle between flange and web	 Compared with template per 100mm in breadth of flange.	±2.5	±4.5	
	Curvature or straightness in the plane of flange	 Per 10m in length.	±10	±25	
	Curvature or straightness in the plane of web	 Per 10m in length	±10	±25	
Flanged Bracket	Breadth of flange	 Compared with correct size	±3.0	±5.0	
	Angle between flange and web	 Compared with template per 100mm in breadth of flange.	±3.0	±5.0	

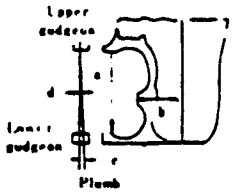
Division		Fabrication			UNIT : mm
Section	Subsection	Item	Standard range	Tolerance limits	Remarks
Template for bending (plane or box shape).	Template in box shape	Location of plate edge, compared with correct one.	±2.0	±4.0	
		Shape of curved surface, compared with correct one.	±2.0	±4.0	For large one ±5.0
	Section template	Location of check line for leveling by sight, compared with correct one. (for transverse)	±1.5	±3.0	
		〃 (for longitudinal)	±1.5	±3.0	
		Shape, compared with correct one.	±1.5	±3.0	
	Other templates	Shape, compared with correct one.	±1.5	±3.0	
Angles & Built up Plates.	Stringer angle	 Compared with template	±1.5	±2.0	
		 Compared with template	±1.0	±1.5	
	Frame & Longi	Curvature compared with template or check line. Per 10m in length.	±2.0	±4.0	
			3.0	5.0	
		 Compared with template	±1.5	±3.0	
		Deviation of face plate 	±1.5	±3.0	

Division		Fabrication				UNIT : mm
Section	Sub-section	Item		Standard range	Tolerance limits	Remarks
Plates	Corrugated bulkhead	Depth of corrugation.		± 3.0	± 6.0	
		Breadth of corrugation, compared with correct ones. Breadth (A) / Depth / Breadth (B)	A	± 3.0	± 6.0	
			B	± 3.0	± 6.0	
	Corrugated wall	 Compared with correct ones	Pitch	±6.0	±9.0	In case where it dose not connect with others.
			Pitch	±2.0	±3.0	In case where it connects with others.
			Depth	±2.5	±5.0	
	Cylindrical structure (mast, post etc)	Diameters 		$\pm \frac{D}{200}$ But, Max. ± 5.0	$\pm \frac{D}{150}$ But, Max. ± 7.5	
	Curved shell plate	In regard to the check line. (for longitudinal)		± 2.5	± 5.0	
		" (for transverse)		± 2.5	± 5.0	
		Gap between shell plate and section template.		± 2.5	± 5.0	
Line heating method	Maximum heating temparature on surface.	• 50HT • TMCP type 50HT (Ceq. >0.38%)	Water cooling just after heating	under 650℃		Ceq. is defined by IACS.
			Air cooling after heating	under 900℃		
			Air cooling and subsequent water cooling after heating	under 900℃ (starting temperature of water cooling to be under 500 ℃)		
		• TMCP type • 50HT (Ceq. ≤0.38%) AH~DH	Water cooling just after heating or air cooling	under 1000℃		
		• TMCP type 50HT (Ceq. ≤0.38%) EH	Water cooling just after heating or air cooling	under 900℃		

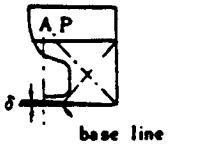
Division: Sub-assembly — UNIT : mm

Section	Subsection		Standard range	Tolerance limits	Remarks
Accuracy of Dimensions	Flat plate Sub-assembly	Breadth of Sub-assembly	± 4	± 6	Cut, when too long.
		Length of Sub-assembly	± 4	± 6 .	Cut, when too long.
		Squareness of Sub-assembly	4	8	Measured difference of diagonal length at final marking lines. When the difference is over the limits, correct the final marking line.
		Distortion of Sub-assembly	10	20	Measured on the face of web-beam or girder.
		Deviation of Interior members from skin plating	± 5	± 10	Excluding the case when interior members are connected by lapped joint.  Accuracy of this dimemsion
	Curved plate Sub-assembly	Breadth of Sub-assembly	± 4	± 8	Measured along the girth. Cut, when too long.
		Length of Sub-assembly	± 4	± 8	Cut, when too long.
		Distorsion of Sub-assembly	10	20	Measured on face of web or girder. Correct the final marking line, when the distorsion exceed the limits.
		Squareness of Sub-assembly	10	15	Difference of base line for marking $\delta = d$  or differance of diagonel lengths at marking $\delta = \lvert \Delta\ell_1 - \Delta\ell_2 \rvert$  marking to be ammended
		Deviation of interior members from skin plating	The same as for the flat plate Sub-assembly		
	Plate Block Sub-assembly	Breadth of each panel	The same as for the flat plate Sub-assembly		
		Length of each panel			
		Squareness of each panel			
		Distortion of each panel			
		Distortion of interior members from skin plating			

Division		Sub-assemly			UNIT : mm
Section	Sub-section	Item	Standard range	Tolerance limits	Remarks
Accuracy of Dimensions	Plate Block Sub-assembly	Twist of Sub-assembly	10	20	Measured as follows:  The point A, B and C are established in the same plane, then measured the deviation of the point D from that plane. May re-assemble partially when the deviation exceed the limits.
		Deviation of upper / lower panel from ℄ or B. L	5	10	 Accuracy of this dimemsion
		Deviation of upper / lower panel from F R.L	5	10	
	Curved plate Block Sub-assembly	Breadth of each panel	The same as for the flat plate Sub-assembly		
		Length of each panel			
		Distortion of each panel			
		Deviation of interior members from skin plating			
		Twist of Sub-assembly	15	25	The same as for the flat plate Sub-assembly
		Deviation of upper / lower panel from ℄ or B.L.	7	15	Re-assemble partially when the deviation exceed the limits.
		Deviation of upper / lower panel from FR.L.	7	15	
	Block Sub-assembly Including Stern frame	Distance between upper / lower gudgeon (a)	± 5	± 10	

Division			Sub-assembly		UNIT : mm
Section	Sub-section		Item	Standard range	Tolerance limits	Remarks
Accuracy of Dimensions	Special Sub-assemblies	Block Sub-assembling Including Stern frame	Distance between aft edge of boss and aft peak bulkhead (b)	± 5	± 10	 (c): twist of plane including ℄
			Twist of Sub-assembly (c)	5	10	
			Deviation of rudder from shaft ℄ (d)	4	8	
			Others	The same as for curved plate block Sub-assembly		
		Rudder	Twist of rudder plate	6	10	Correct or re-assemble partially
			Others	The same as for the curved plate block Sub-assembly		
		Main engine bed	Flatness of top plate of main engine bed	5	10	
			Breadth and length of top plate of main engine bed	± 4	± 6	
			Others	The same as for flat plate block Sub-assembly		

Division		Accuracy of hull form			UNIT : mm
Section	Sub-section	Item	Standard range	Tolerance limits	Remarks
Principal Dimensions	Length	Length between Perpendiculars	± 50 Per 100m	not defined	Applied to ships of 100 meters length and above. For the convenience of the measurement the point where the keel is connected to the curve of the stem may be substituted for the fore perpendicular in the measurement of the length.
		Length betweeen aft edge of boss and main engine	± 25	not defined	For the accuracy in accordance with the shaft length.
	Breadth	Molded breadth Amidships	±15	not defined	Applied to ships of 15 meters breadth and above. Measured on the upper deck.
	Depth	Molded depth Amidships	±10	not defined	Applied to ships of 10 meters depth and above.

Division		Accuracy of hull form			UNIT : mm
Section	Sub-section	Item	Standard range	Tolerance limits	Remarks
Deformation of hull form	Flatness of Keel	Deformation for the whole length	± 25	not defined	Ups (−) and Downs (+) against the check line of keel sighting.
		Deformation for the distance between two adjacent bulkheads	± 15	not defined	Sighting by the transit or slits. Local unfairness, which see DIVISION: Deformation
	Cocking-up	Cocking-up of Fore-body 	± 30	not defined	Ups (−) and Downs (+) against the check line of the keel at the foremost frame on the flat part of the keel.
		Cocking-up of Aft-body 	± 20	not defined	Ups (−) and Downs (+) against the check line of the keel at the aft-perpendicular.
	Rise of Floor	Rise of floor amidships 	± 15	not defined	The height of the lower turn of the bilge, compared with the planned height. Measured from the plane passing through the outer surface of the keel plate.

JAPANESE SHIPBUILDING QUALITY STANDARD

(J.S.Q.S.)

(OUT FITTING PART)

EXCERPT ONLY

1991

Preface

It goes without saying that production control is an imperative need to help the progress of modern industries.

Besides, quality control is heavily involved with the production control as a whole.

The responsibility of manufacturers for customers is to guarantee against the final quality of products produced by the manufacturers.

In the process of shipbuilding, the outfit work is frequently dealt with qualitatively rather than quantitatively in respect of the accuracy control which comes into question in workmanship and products because of the broad range of products, functions and procedures to be dealt with.

Consequently, there are cases where opinions differ among classification societies, ship's owners, shipyards and manufacturers of fittings, who are in divergent situations.

For the sake of preventing foreseen problems, it is hoped that some measures are established so that it is utilized as standards of common judgement.

In accordance with the present standards of accuracy, we have set about to determine the maximum allowable range in contr-oling the quality of products by grasping quantitatively the levels of accuracy which is being adopted by Japanese shipbuilders.

For this purposes, the data on actual situations have been collected from shipbuilders throughout the country.

The data have been so arranged as to form the "tolerance limits" consisting of criteria for practicaly control of the production, and for check of conformity to the designed quality at the final stage of the construction.

As for the stardard of accuracy, the "standard range" has been established to ensure the tolorance limits in the production process.

The contents are a collection of standardized items on nati-

onal basis, taking into account the common level of the Japanese shipyards for making final decisions.

This standard is expected to be employed as a common guide line, together with the previously published Japanese shipbuilding Quality Standard (the hull structure version), by classification societies, shipowners, shipbuilders and related manufacturers to realize rationalization of effective production control, reduction in production cost and good quality not only from the shipbuilder's point of view but also from the view point of all the parties concerned.

July 1969

Fumio Hiramoto
Chairman,
2 nd Subcommittee of Research Committee on Steel Shipbuildiding,
The Society of Naval Architect of Japan.

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PREFACE

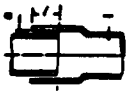
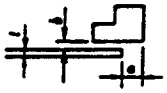
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II WOODEN WORK 17
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IV APPLIANCE EQUIPMENT 25

Division Ⅲ－A Manufacturing

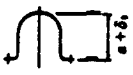
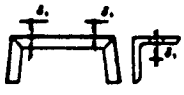
Section 2 Bending dimension of pipe

Sub-section	Item		Nominal dia.	Standard range	Tolerance limits	Figure	Remarks
				unit mm			
1 Prefabricated pipe	a Straight pipe	δ_1		±6	*		l =designed dimension θ =designed bending angle *:not defined
	b ①Bent pipe	δ_1		±6	*		
		δ_2		±5	*		
		$\delta\theta_1$		±1°	*		
	②Bent pipe	δ_1		±6	*		
		δ_2		±5	*		
		δ_3		±6	*		
		$\delta\theta_1$		≦2°	*		
		$\delta\theta_2$					
	c Three-dimensional bent pipe	δ_1		±5	*		
		δ_2		±5	*		
		δ_3		±5	*		
		$\delta\theta_1$		±1°	*		
		$\delta\theta_2$		±1°	*		
	d Branch pipe	δ_1		±5	*		
		δ_2		±5	*		
		δ_3		±5	*		
		$\delta\theta_1$		±1°	*		
	e Penetration piece	δ_1		±4	*		
		δ_2		±4	*		
		$\delta\theta_1$		±1°	*		
	f Fitting angle of flange	δ_1		2	*		
	g Distorsion of flange face	δ_1	more than 500A	≦1.5	<2.5		
			200A～450A	≦1.0	<2.0		
			less than 200A	≦0.5	<1.0		
	h Warp of pipe (per 1m)	δ_1	more than 400A	<1.5	*		
2 Pipe joint (Steel pipe)	a Flange joint	a		(t±2)±1	*		*:not defined
		b		≦1.5	*		
		δ_1		0～1.5	<2		
	b Sleeve	a		1～3	*		a,b vary according to pipe dia.
		b		≧3t	*		

Section 2 Bending dimension of pipe

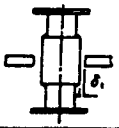
Sub-section	Item		Nominal dia.	Standard range	Tolerance limits	Figure	Remarks
				unit mm			
3 Pipe joint (Copper pipe & Al-brass pipe)	a Flange joint (Silverbrazing)	a		≦0.2	*		*:not defined
		b		≦1.0	*		
	b Flange joint (Brassbrazing)	a		≦0.2	*		
	c Sleeve joint (Silverbrazing)	a		≦0.2	*		
		b		≦1.0	*		
	d Sleeve joint (Silverbrazing)	a		≦0.2	*		
		l		≧5t	*		
4 Pipe joint (TIG welding to Al-brass pipe)	a Flange joint	a		t～t+1.5	*		*:not defined
		b	<50A	0～1.5	*		
			>65A	0～2.0	*		

Section 3 Manufacture dimension of band

Sub-section	Item			Standard range	Tolerance limits	Figure	Remarks
				unit mm			
1 U-bolt	a Difference between both ends of U-bolt	δ_1		≦d/2	*		d=Dia. of U-bolt
	b Pitch of U-bolt	δ_1		±2	*		a=designed dimension *:not defined
2 Flat steel band	a Pitch of bolt hole	δ_1		±2	*		*:not defined
	b Height of band	δ_1		-2～0	*		
3 Support	a Location of bolt hole	δ_1		±2	*		*:not defined

Division Ⅲ－B Instralation of pipe

Section 1 Penetration hole and penetration piece of pipe

Sub-section		Item		Standard range	Tolerance limits	Figure	Remarks
				unit mm, μ			
1 Penetration hole	a	Sectional roughness In way of hull strength members		400(μ)	800(μ)		1. Hull strength members means shell, upp. deck bulkhead. 2. In case where it is necessary to be smoothly finished by grinder, or where it is over tolerance limits, it is to be repaired by appropriate method.
		Others		800(μ)	1500(μ)		
2 Sleeve type penetration piece	a	Clearance	δ_1	≦3mm	≦5mm		

Section 2 Bolt for fastening of pipe flange

Sub-section		Item		Standard range	Tolerance limits	Figure	Remarks
				unit mm			
1 Bolt length	a	Length of protruding parts from nut, after fastening	a	0～3 threads	*		*: not defined

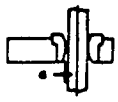
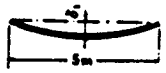
Section 3 Fitting of band

Sub-section		Item		Standard range	Tolerance limits	Figure	Remarks
				unit mm			
1 Band fastening	a	Clearance between pipe and U-bolt or flat steel band	a	1≦a≦3	*		Applied to necessary part only
	b	Length of band protruding from nut	a	0～5 threads	*		*: not defined

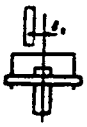
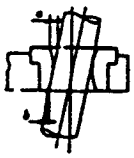
Section 4 Dresser coupling

Sub-section		Item		Standard range	Tolerance limits	Figure	Remarks
				unit mm			
1 Dresser coupling fastening	a	Clearance between pipe ends	δ_1	±10	*		*: not defined
	b	Alignment of pipe	δ_1	±3	±5		

Section 1 Manufacturing of reach rod

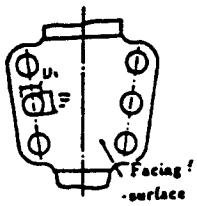
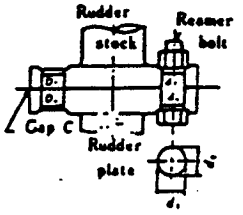
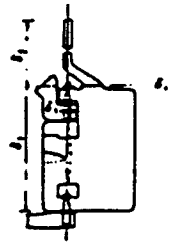
Sub-section	Item		Standard range	Tolerance limits	Figure	Remarks
			unit mm			
1 Reach rod	a Clearance between reach rod and bearing	a	D>25A 0.5≦a≦1.5	*		D:reach rod dia. *:not defined
			D>32A 0.5≦a≦2.0	*		
	b Straightness of spindle(per 5m)	δ	≦10	*		
	c Clearance between reach rod and joint piece	a	0.2≦a≦1.0	*		

Section 2 Fitting of reach rod

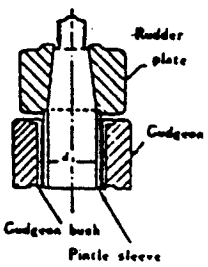
Sub-section	Item		Standard range	Tolerance limits	Figure	Remarks
			unit mm			
1 Reach rod	a Spindle end spacing	a	≦10	*		*:not defined
	b Free length of taper pin	b	5≦b≦8	*		
	c Straightness of reach rod (per 5m)	δ_1	≦10	*		
	d Missalignment between valve spindle and reach rod	δ_2	≦10	*		
	e Fitting angle of deck stand	$\lvert\delta\theta_1\rvert$	≦1°	*		
	f Deviation of reach rod from perpendicular to bearing	$\lvert a-b \rvert$	≦1	*		

Division Ⅳ-A Rudder

Section 1. Rudder plate and rudder stock

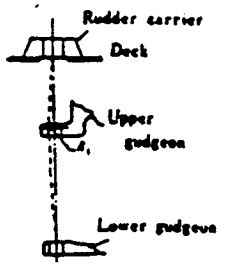
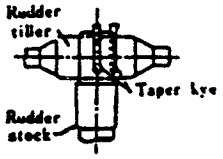
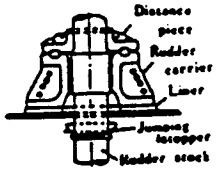
Sub-section		Item		Standard range	Tolerance limits	Figure	Remarks
				unit	mm		
1 Reamer	a	Dimension of reamer bolt hole					Di:dia. of bolt di:dia. of hole
		Roundness	$\lvert D_1-D_2\rvert$		≦0.01		
		Cylindrical	$\lvert D_1-D_3\rvert$		≦0.02		
	b	Dimension of reamer bolt hole					
		Roundness	$\lvert d_1-d_2\rvert$		≦0.01		
		Cylindrical	$\lvert d_1-d_3\rvert$		≦0.02		
	c	Interference of reamer bolt	d-D	0.005 ~0.015	>0		
2 Join	a	Facing surface area between rudder plate and rudder stock		>60%	•		•not defined
	b	Deviation from the center line of rudder and rudder stock after connection	δ_1	≦0.3	≦0.5		Both longitudinal and transverse deviations are to comply with this standard
		Length of rudder plate and rudder stock after connection					
	c	Length of rudder stock	δ_2	±3	•		
	d	Length of rudder plate	δ_3	±4	•		
	e	Total length	$\delta_2+\delta_3$	±5	•		
	f	Gap between rudder plate and rudder stock after connection	δ_4	<0.03	•		After tightning of reamer bolt
3 Sleeve of rudder stock		Interference for sleeve of rudder stock					•not defined
	a	(SUS)	d_3-d_4	$\frac{(5\sim10)d_3}{10,000}$	•		d_3:dia. of rudder stock
	b	(BC)	d_3-d_4	$\frac{(10\sim20)d_3}{10,000}$	•		d_4:inside dia. of sleeve

Section 2. Pintle and gudgeon bush

1 Pintle	a	Facing surface area between pintle and taper of rudder plate		>60%	•		•not defined
		Interference of pintle and sleeve					d_1:outside dia. of pintle d_2:inside dia. of sleeve
	b	(SUS)	d_1-d_2	$\frac{(5\sim10)d_1}{10,000}$	•		
	c	(BC)	d_1-d_2	$\frac{(10\sim20)d_1}{10,000}$	•		
2 Gudgeon bush		Interference of gudgeon bush					•not defined d_3:inside dia. of gudgeon d_4:outside dia. of bush
	a	(BC, SUS)	d_4-d_3	0~0.05	•		
	b	(Synthetic resin)	d_4-d_3		•		

Division IV-A Rudder

Section 3. Stern frame

Sub-section		Item		Standard range (unit: mm)	Tolerance limits (unit: mm)	Figure	Remarks
1 Gudgeon center line	a	Alignment of center line for rudder carriers, upper & lower gudgeons after boring, or after creaming eccentric bush	δ_1	≦0.3	≦0.5		Both longitudinal and transverse deviations are to comply with this standard
Section 4. Rudder tiller							
1 Rudder stock and tiller	a b	Interference of rudder stock and tiller Interference of taper key		0.005 ~0.015	>0 >0		
2 Rudder stock and tiller with taper	a b	Facing surface area between rudder stock and tiller Fastening clearance of taper key		>60% 0.005 ~0.015	• >0		•not defined
Section 5. Rudder carrier and stuffing box							
1 Installation	a b	Facing surface area of liner Gap between rudder carrier and liner		>50% <0.05	• •		•not defined This standard is also applied to that of stuffing box To be measured in the condition before tightning of up bolts

Division IV-B Steering engine

Section 1. Ram cylinder type

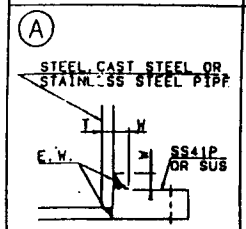
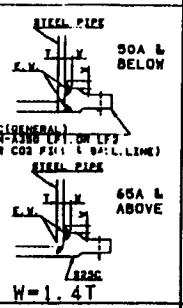
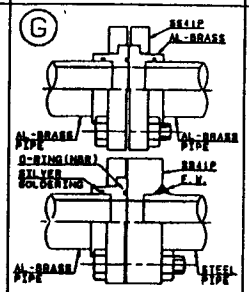
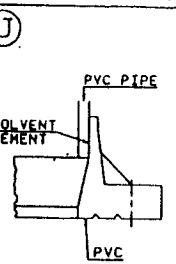
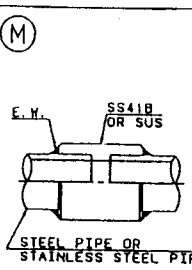
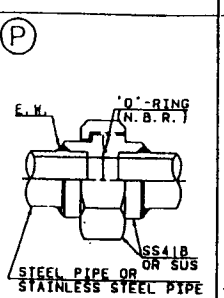
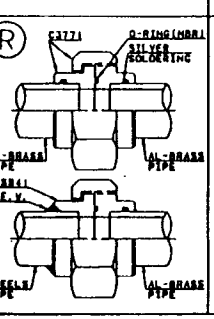
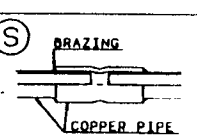
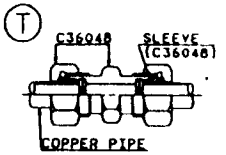
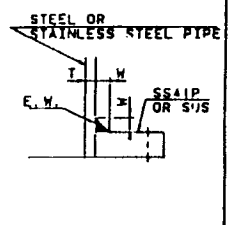
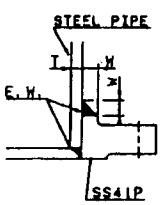
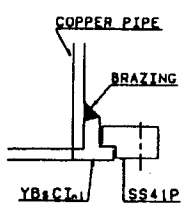
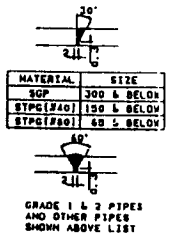
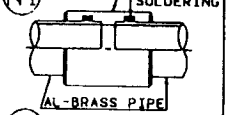
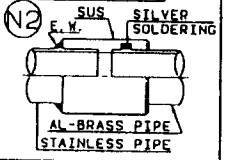
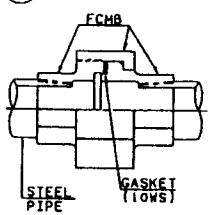
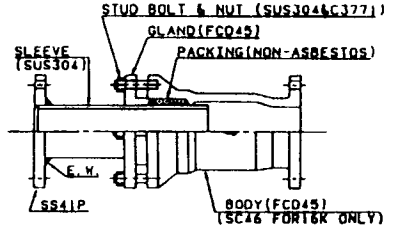
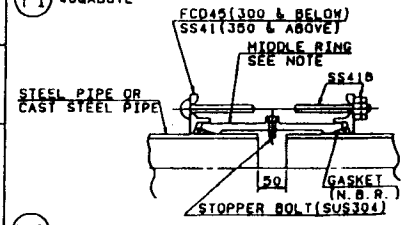
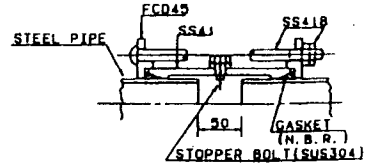
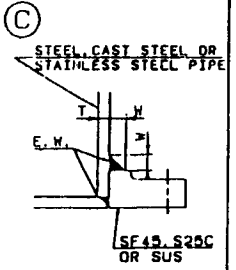
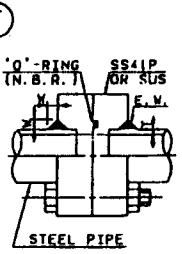
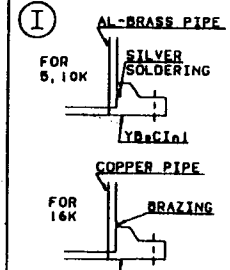
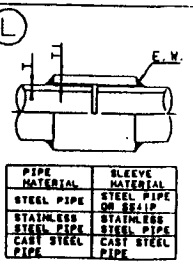
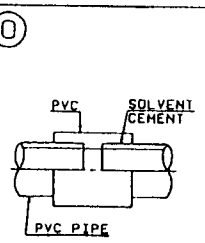
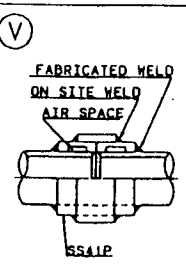
1 Reamer bolt	a	Interference	d-D	0.01	>0		d: dia. of bolt D: dia. of hole
2 Installation of liner (Top liner Chock liner)	a	Clearance		<0.06	•		•not defined In the condition before tightning of bolts
3 Level and torsion of ram cylinder	a	Level and torsion		$\leqq \frac{10}{100}$	Within 75% of clearance of ram cylinder		

ATTACHMENT (B)

- **Representation of Standards Used - Excerpt from Diagram Booklet**

OUTLINE OF PIPE JOINT

P.1.1

5 & 10 kg/cm2 SLIP-ON FLANGE	20, 30 & 40 kg/cm2 SLIP-ON FLANGE	140kg/cm2 SOCKET FLANGE	5 kg/cm2 SOCKET FLANGE	COUPLING	UNION	UNION	SOCKET & UNION
(A)  W=1.4 T	(D)  W=1.4T	(G) 	(J) 	(M) 	(P) 	(R) 	(S)  (T) 
5 & 10 kg/cm2 SLIP-ON FLANGE	ANSI 150 PSI SLIP-ON FLANGE	5 & 10 kg/cm2 BUILT-UP FLANGE	BUTT WELDING	COUPLING	UNION	5, 10 & 16 kg/cm2 SLEEVE TYPE EXPANSION JOINT AND DRESSER TYPE EXPANSION JOINT	
(B) 200 & BELOW  W=1.4 T	(E)  W=1.4 T	(H) 	(K) 	(N1) AL-BRASS SILVER SOLDERING  (N2) SUS SILVER SOLDERING 	(Q) 	(W)  (Y1) 40&ABOVE  (Y2) 32&UNDER 
16 kg/cm2 SLIP-ON FLANGE	280kg/cm2 SOCKET FLANGE	5, 10 & 16 kg/cm2 SOCKET FLANGE (50 & BELOW)	SLEEVE	SOCKET	SLEEVE		
(C)  W=1.4 T	(F)  W=1.4 T	(I) 	(L)  T1≧T	(O) 	(V) 		

NOTE: MATERIAL OF MIDDLE RING FOR DRESSER TYPE EXPANSION JOINT. (Y1)

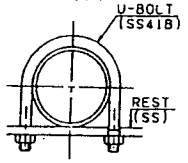
FOR STEEL PIPE ------- [STPG38 (125&ABOVE) / SS41P (150&BELOW)

FOR CAST STEEL PIPE --- SC

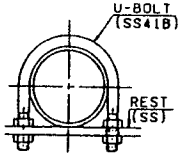
OUTLINE OF PIPE BAND

STEEL PIPE (STAINLESS PIPE)

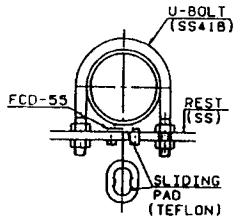
(A) 80 & BELOW



(B1) 100 & ABOVE

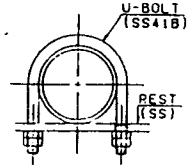


(B2) LONGITUDINALLY RUNNING PIPES OF CARGO AND INERT GAS LINES ON UPPER DECK



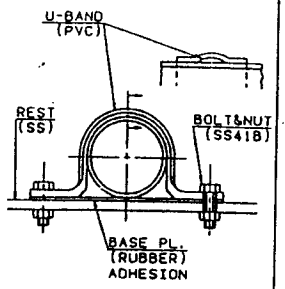
TANK HEATING STEEL PIPE IN F.O.T.

(C)

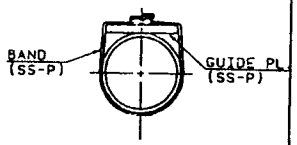


PLASTIC PIPE (PVC)

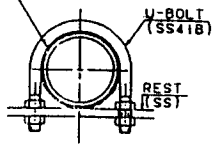
(D)



(E)

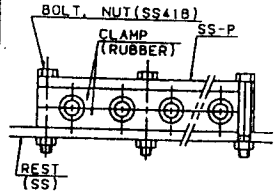


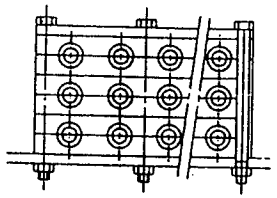
(F) ANCHORED SUPPORTS
NEOPRENE SHEET(2mm)
LOOSE SUPPORTS
GLASS FIBER CLOTH



HYD. OIL STEEL PIPE

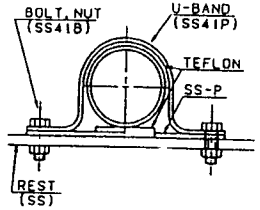
(G) 20 & BELOW



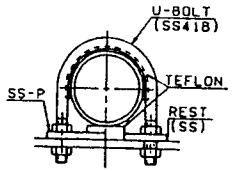


STEAM PIPE WITH ALMINIUM DIPPING

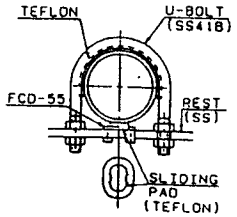
(H) 25 & BELOW



(I) 32, 40 & 50

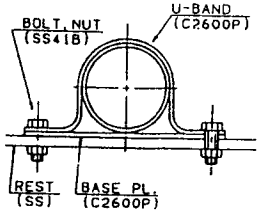


(J) 65 & ABOVE

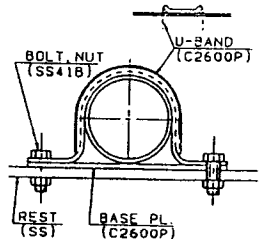


AL-BRASS PIPE OR COPPER PIPE

(K) 32 & BELOW

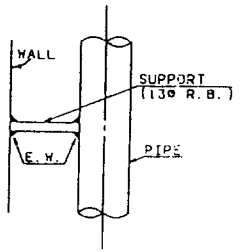


(L) 40 & 50



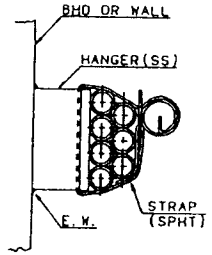
SUPPORT FOR SWEAT SCUPPER PIPE

(M)

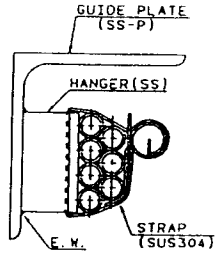


COPPER PIPE FOR CONTROL AIR

(N) ENCLOSED SPACE

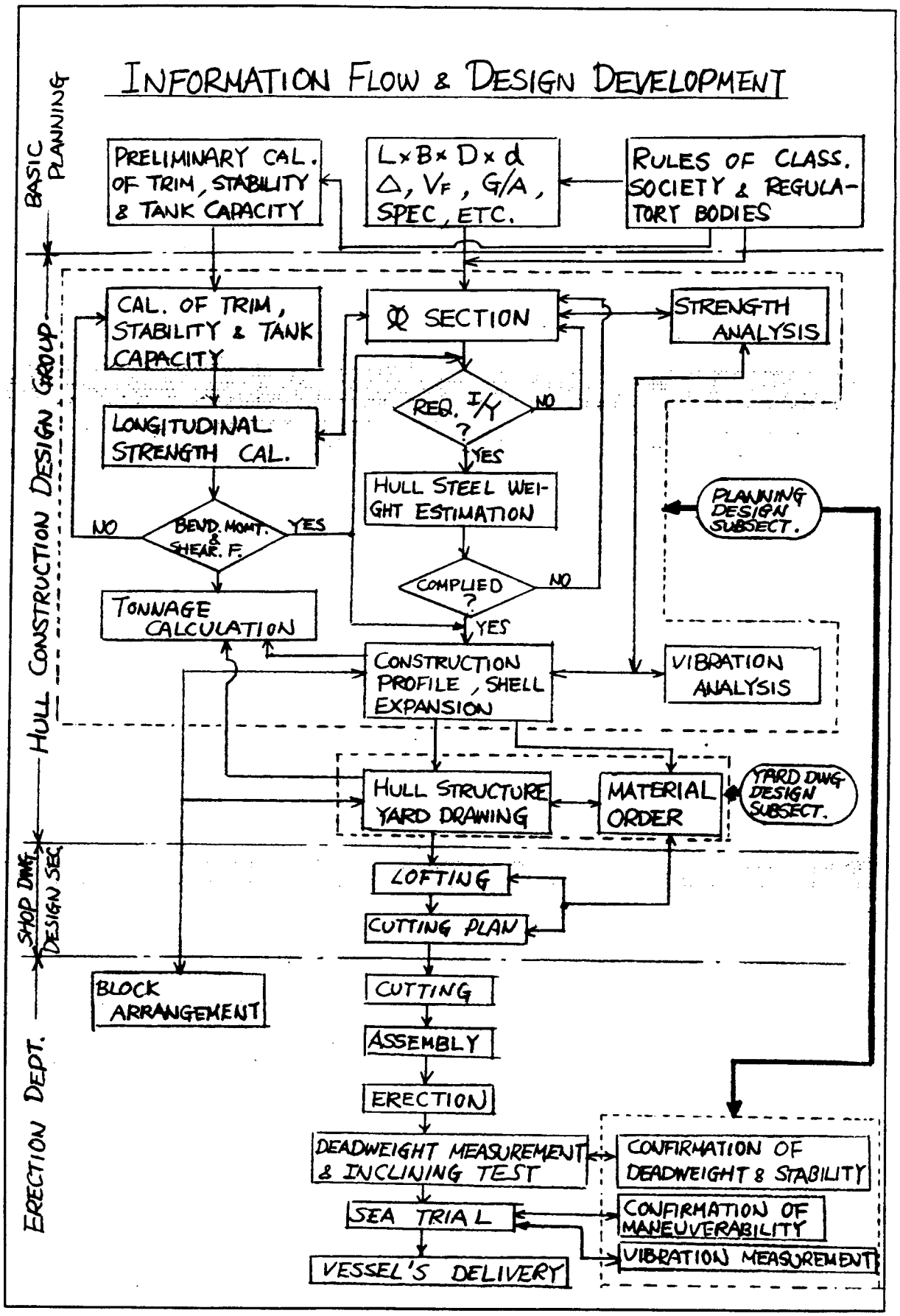


(O) EXPOSED SPACE



ATTACHMENT (C)

- **Typical Information Flow and Design Development - Hull and Outfitting Depts.**


INFORMATION FLOW & DESIGN DEVELOPMENT
BASIC PLANNING
PRELIMINARY CAL. OF TRIM, STABILITY & TANK CAPACITY
L×B×D×d △, VF, G/A, SPEC, ETC.
RULES OF CLASS. SOCIETY & REGULATORY BODIES
HULL CONSTRUCTION DESIGN GROUP
CAL. OF TRIM, STABILITY & TANK CAPACITY
SECTION
STRENGTH ANALYSIS
LONGITUDINAL STRENGTH CAL.
REQ. I/Y ?
NO
YES
HULL STEEL WEIGHT ESTIMATION
PLANNING DESIGN SUBSECT.
NO
BEND. MOMT. & SHEAR. F.
YES
COMPLIED ?
NO
YES
TONNAGE CALCULATION
CONSTRUCTION PROFILE, SHELL EXPANSION
VIBRATION ANALYSIS
HULL STRUCTURE YARD DRAWING
MATERIAL ORDER
YARD DWG. DESIGN SUBSECT.
SHOP DWG. DESIGN SEC.
LOFTING
CUTTING PLAN
BLOCK ARRANGEMENT
CUTTING
ASSEMBLY
ERECTION
ERECTION DEPT.
DEADWEIGHT MEASUREMENT & INCLINING TEST
CONFIRMATION OF DEADWEIGHT & STABILITY
SEA TRIAL
CONFIRMATION OF MANEUVERABILITY
VIBRATION MEASUREMENT
VESSEL'S DELIVERY

* Approval drugs for customer and Classification Societies

JOBS IN HULL STRUCTURE DESIGN GROUP
(TYPICAL)

PLANNING DESIGN SUBSECTION

* 1. DRAWING

1) MIDSHIP SECTION
2) CONSTRUCTION PROFILE & DECKS
3) ENGINE ROOM CONST.
4) AFT BODY CONST.
5) FORE BODY CONST.
6) ACCOMMODATION HOUSE CONST.
7) SHELL EXPANSION
8) STERN FRAME CONST.
9) STERN TUBE CONST.
10) STOCK CONST.
11) UPPER BEARING FOR RUDDER
12) RUDDER CONST.
13) DECK CRANE POST
14) DERRICK POST
15) SCHEME OF COMPARTMENT TEST

2. ANALYSIS

1) HOLD STRUCTURE STRENGTH ANALYSIS (TRANS RING, TRANS BHD, DOUBLE BOTTOM STRUCTURE)
2) HOLD STRUCTURE FATIGUE LIFE ANALYSIS
3) HOLD STRUCTURE BUCKLING ANALYSIS
4) FORWARD BOTTOM STRUCTURE STRENGTH ANALYSIS AGAINST SLAMMING
5) TORSIONAL STRENGTH ANALYSIS
6) HULL GIRDER VIBRATION ANALYSIS
7) SUPERSTRUCTURE VIBRATION ANALYSIS
8) ENGINE ROOM & AFT BODY VIBRATION ANALYSIS
9) ENGINE ROOM DOUBLE BOTTOM DEFLECTION & VIBRATION ANALYSIS
10) CRANE POST & FOUNDATION STRUCTURE ANALYSIS

PLANNING DESIGN SUBSECTION (CONTINUED)

3. CALCULATION

1) HYDROSTATIC CAL.

2) TRIM CAL.

3) INTACT STABILITY CAL.

4) DAMAGE STABILITY CAL.

5) TANK CAPACITY CAL.

6) TONNAGE CAL.

7) FREEBOARD CAL.

8) PROTECTIVE LOCATION CAL.

9) LONGITUDINAL STRENGTH CAL.

10) SECTION MODULUS CAL.

11) SHEAR FLOW CAL.

12) PLASTIC STRENGTH CAL. OF FORE END STRUCTURE

13) DERRIC POST & BOOM STRENGTH CAL.

14) HULL STEEL WT. CAL.

15) LOCAL VIBRATION CAL. IN ACCOMMODATION HOUSE

16) EMPIRICAL VIBRATION CAL. OF SUPERSTRUCTURE

17) LOCAL VIBRATION CAL. IN ENGINE ROOM

18) LOCAL VIBRATION CAL. IN A.P. TANK

19) DOCKING CALCULATION

20) CLASS. RULE CAL.

4. TEST, MEASUREMENT, ETC.

1) DEADWEIGHT MEASURE.

2) INCLINING TEST

3) CIRCLE TEST

4) INERTIA TEST

5) VIBRATION MEASUREMENT

6) LOADING MANUAL

YARD DRAWING DESIGN SUBSECTION

1. STEEL MATERIAL

1) ROUGH NESTING OF STEEL MATERIALS

2) PLACING ORDER OF STEEL MATERIALS

2. DRAWING

1) MIDSHIP TYPICAL SECTION DWG.

2) ERECTION BLOCK ARRANGEMENT DWG.

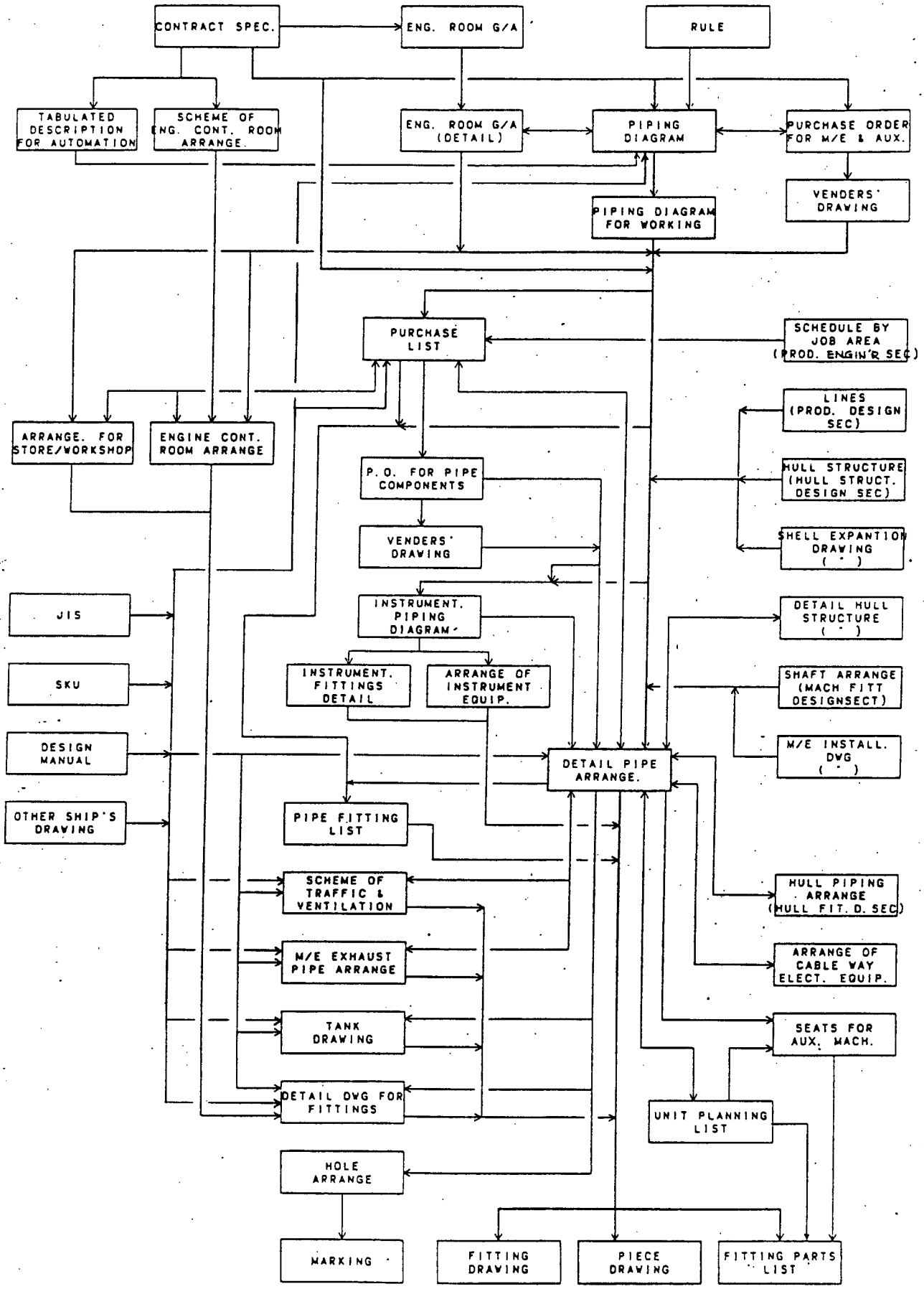
3) YARD DWG FOR EACH BLOCK

4) WELDING SCHEME

5) ARRANGEMENT OF BOTTOM PLUG

CC-10

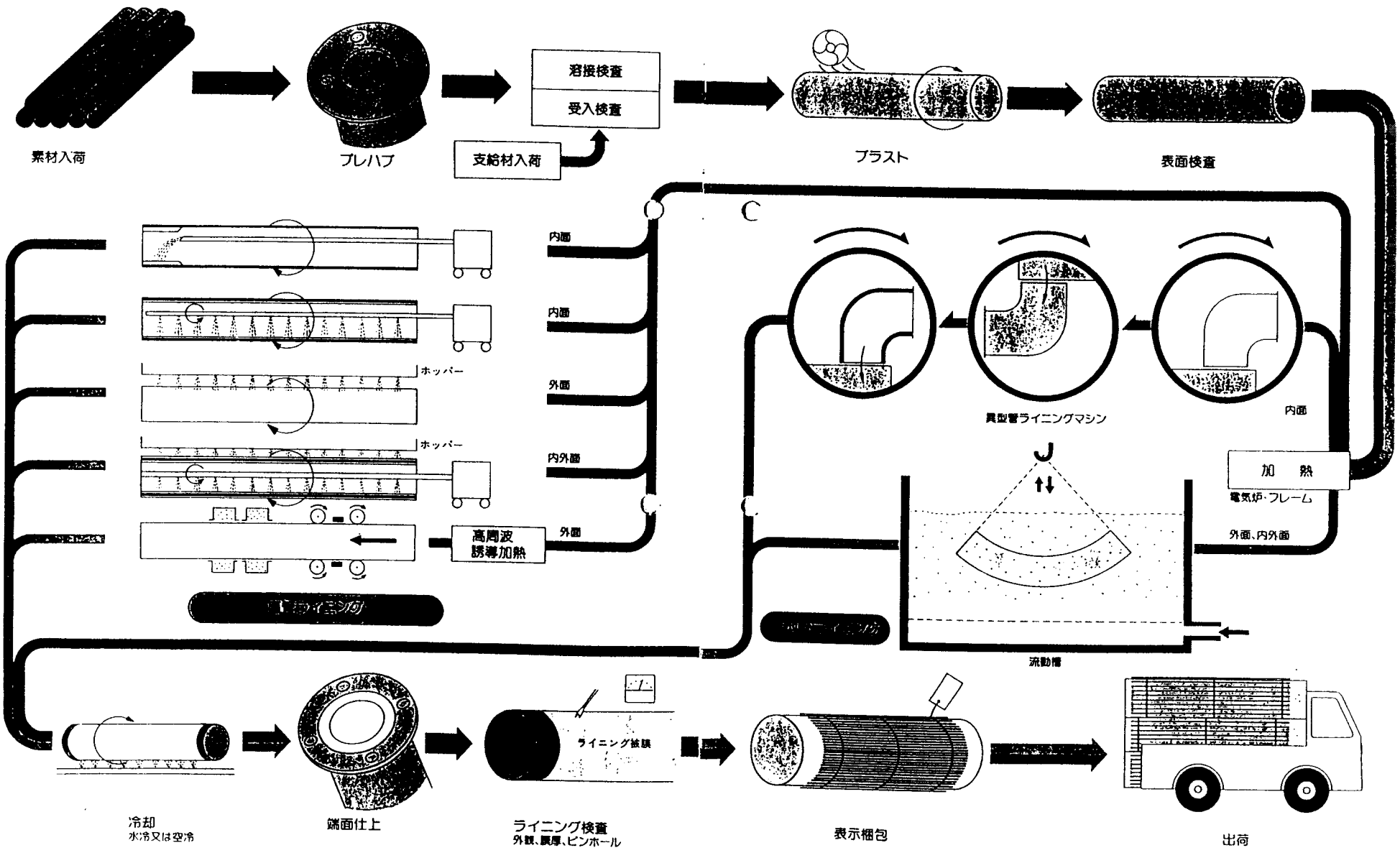
DRAWING FLOW IN MACHINERY FITTING DESIGN SECTION



ATTACHMENT (D)

- **Steel Pipe Poly Coating Application - Pictorial Process Flow**

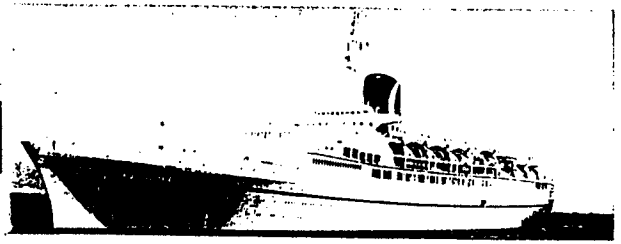
ライニング鋼管の製造方法

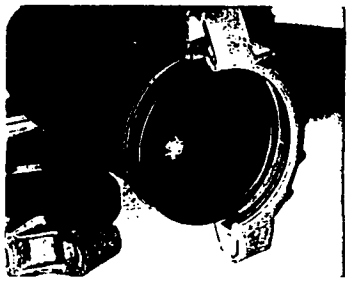


内面ライニング

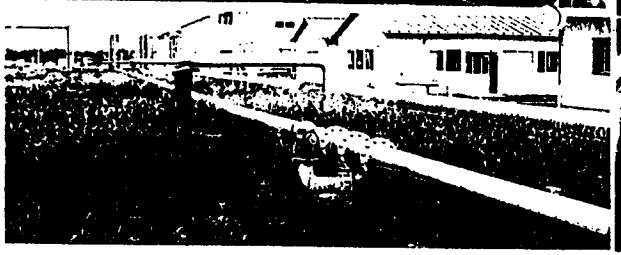
鋼管の強度プラスすぐれた耐蝕性をもった内面被膜。
海水の輸送・薬液の輸送・純水装置・上下水道・水処理・船内配管・化学・原子力などに。
内面の被膜は非常に滑らかで、流頭損失も少くなります。又無極性分子のため、貝殻や藻の付着がほとんどありません。







メカニカルジョイント

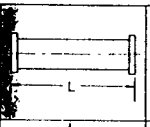


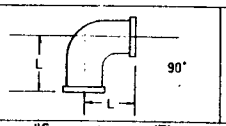
消火栓ライン

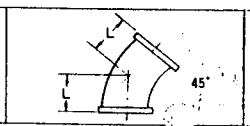


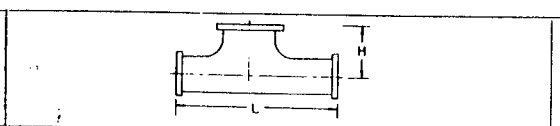
内面ライニング鋼管が、海水、清水、造水全ラインに使用されています。

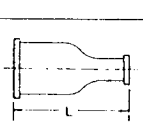
HIGH-COAT-PE 規格寸法(直管、エルボ、ティー、レジューサー)











呼径 A	呼径 B	外径 D(mm)	肉厚 t(mm)	L (m)	90° JIS L(mm)	90° JPI L(mm)	45° JIS L(mm)	45° JPI L(mm)	ティー JIS L(mm)	ティー JIS H(mm)	ティー JPI L(mm)	ティー JPI H(mm)	レジューサー JIS L(mm)	レジューサー JPI L(mm)	呼径 B
20	3/4	27.2	2.8	2.75	80	80	60	60	150	75	150	75	130	140	1×3/4
25	1	34.0	3.2	5.5	90	90	60	60	170	85	170	85	140	150	1 1/4×1
32	1 1/4	42.7	3.5	〃	90	100	70	70	190	95	190	95	150	160	1 1/2×1
40	1 1/2	48.6	3.5	〃	100	110	75	80	200	100	220	110	170	180	2×1
50	2	60.5	3.8	〃	120	130	80	90	220	110	240	120	190	210	2 1/2×1 1/2
65	2 1/2	76.3	4.2	〃	140	160	90	100	240	120	280	140	190	220	3×2
80	3	89.1	4.2	〃	160	180	100	110	300	150	300	150	210	240	4×3
100	4	114.3	4.5	〃	200	220	120	130	320	160	340	170	230	270	5×4
125	5	139.8	4.5	〃	240	260	140	150	340	170	400	200	260	290	6×5
150	6	165.2	5.0	5.5	280	310	160	170	380	190	440	220	280	330	8×6
200	8	216.3	5.8	5.5又は11.0	360	390	180	220	460	230	540	270	320	380	10×8
250	10	267.4	6.6	〃	440	480	220	260	540	270	640	320	350	420	12×10
300	12	318.5	6.9	〃	520	570	250	300	640	320	720	360	500	560	14×12
350	14	355.6	7.9	〃	600	650	290	340	700	350	800	400	550	620	16×14
400	16	406.4	7.9	5.5又は11.0	680	730	320	380	740	370	860	430	580	660	18×16
450	18	457.2	7.9	6.0又は12.0	770	820	360	420	820	410	940	470	710	790	20×18
500	20	508.0	7.9	〃	860	910	390	460	900	450	1040	520	710	810	22×20
550	22	558.8	7.9	〃	960	990	430	500	980	490	1110	570	710	810	24×22
600	24	609.6	10.3	〃	1050	1080	470	540	1000	500	1130	590			
650	26	660.4	11.1												
700	28	711.2	11.9												
750	30	762.0	11.9												
800	32	812.8	11.9												
850	34	863.6	12.7												
900	36	914.4	12.7												
1000	40	1016.0	10.3												
1100	44	1117.6	11.1												
1200	48	1219.2	11.9												
* 1350	54	1371.6	12.7												
* 1500	60	1524.0	15.1												

備考

1. 管は原則としてプレーンけがきとし、フランジはJIS10[illegible]
2. 10K JPI 150[illegible]
3. 標準肉厚は1mmとします
4. 表示寸法はライニング厚みは含みません
5. [illegible]
6. 呼径500[illegible]

ATTACHMENT (E)

- **Contract Specification Index and Representative Sections for VLCC**

Attachment (E) to Enclosure (1)
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5-1 Rules and Regulations

The Vessel to comply with the following rules and regulations which are in force at the time of signing the Contract.

Any alteration in rules and regulations or any new rules and regulations which comes into force after signing the Contract to be treated as a change in the Specifications as described in the Shipbuilding Contract and to be subject to separate negotiation between the Owner and the Builder in respect of cost adjustment, building schedule, deadweight adjustment, etc.

(1) Classification Rule

The Vessel, including its equipment and propelling machinery, to be built under the survey of American Bureau of Shipping and to be distinguished in the Register Record Book by the class notation + A1,(E), Oil Carrier, + AMS, + ACCU, "SH".

(2) Flag

The Vessel to be registered under the flag of Kuwait.

(3) Other rules and regulations

a) International Convention on Load Lines, 1966

b) International Convention for the Safety of Life at Sea, 1974 incl. Protocol of 1978 relating to the same, 1981 and 1983 amendments and 1988 amendments regarding GMDSS and 1992 amendment where applicable.

c) International Tele-Communication, The Radio Regulations, 1982.

d) International Convention for the Prevention of Pollution from Ships, 1973 (Annex I and V) incl. Protocol of 1978 and 1992 amendment regarding Regulation 13F (double hull design).

e) Regulations of the Country of Registry

f) Rules of Navigation of Suez Canal Authority, including Regulation for the Measurement of Tonnage.

g) International Convention for the Prevention of Collisions at Sea, 1972.

h) U.S. Coast Guard Regulations for foreign flag vessels operating in the navigable waters of the United States (CFR 33 Part 155, 156.00 - 156.170, 157, 159 and 164 without certificate nor inspection) including double hull standards as described in the Interim Final Rule dated 12 August, 1992.

i) Standard for Arrangement of Oil Tanker Manifolds according to Oil Companies International Marine Forum (O.C.I.M.F.).

j) Standard for Equipment Employed in the Mooring of Ships at Single Point Moorings according to O.C.I.M.F.

k) IMO Recommendation for noise level (to be applied to accommodation compartments and engine control room as described in SECTION 10).

l) ISO Guide line proposal No. 6954 for vibration level (to be applied to accommodation compartment as described in SECTION 10).

m) OCIMF Guidelines and Recommendations for Safe Mooring of Large Ships at Piers and Sea Islands

n) OCIMF Mooring equipment guidelines (1992) regarding safe mooring of large ships, single point mooring and ship to ship transfer

o) The amendments to SOLAS at IMO MSC.63 regarding navigation bridge visibility

5-2 Certificates

The Builder at his expense to obtain the following certificates and deliver to the Owner at the time of the Vessel's delivery :

In case the formal certificate(s) cannot be obtained at the time of the Vessel's delivery, the Builder to furnish the Owner with provisional certificate(s) instead. If application after the delivery of the Vessel is necessary to get the formal certificate(s), the application to be done by the Owner.

	Certificate	Issued By
a)	Classification	Classification Society
b)	Load Line	Classification Society
c)	Safety Radiotelegraphy	Classification Society
d)	Safety Equipment	Classification Society
e)	Safety Construction	Classification Society
f)	Tonnage	Classification Society
g)	Suez canal Tonnage	Classification Society
h)	International Oil Pollution Prevention Certificate in accordance with Annex I of Marpol 73/78 (The Certificate for an oil tanker)	Classification Society
i)	Deratting Exemption	Japanese Government
j)	Test Certificates for Anchor and Chain Cable	Classification Society
k)	Deadweight	Builder
l)	Cargo Gear Certificate (for cargo hose handling crane, provisions & machinery parts davits)	Builder
m)	Builder's Certificate	Builder
n)	Other certificates such as those for navigation lights and magnetic compass issued by the regulatory bodies or authorized parties, compass adjustment record issued by the Builder and direction finder calibration record issued by the manufacturer.	

SECTION 6. MATERIAL, STANDARD, WORKMANSHIP, ETC.

6-1 Material and Standard

(A) Material

Structural materials, including forgings and castings, to be of such quality as approved by the Classification Society where required by the Classification Rule.

Neither asbestos nor PCB (Polychlorinated Bephenyl) to be used in the Vessel.

Tolerance in thickness of casted and forged products for fittings, valves, etc., to be in accordance with Japanese Industrial Standard (JIS).

(B) Standard

Following standards to be applied to the construction of the Vessel as far as practicable except the fittings specially described hereinafter.

a) Japanese Industrial Standard (JIS)
b) Builder's engineering standard (SKU)

Metric units to be adopted for the design and construction of hull, machinery, equipment, etc.

All measuring units such as horse power, pressure gauge, thermometer, volume gauge, etc., to be in accordance with the metric system.

The unit of horse power to be 75 kg-m per second, and the pressure to be expressed in gauge pressure in terms of kg/cm2 or in cm mercury unless otherwise described in the Specifications.

Following parts to be used throughout the Vessel unless otherwise specified in the Specifications.

a)	Grease nipple	: JIS pin type
b)	Screw, bolt & nut	: JIS standard in general
c)	Name plate	: written in English
d)	Caution plate	: written in English

Material of name plates and caution plates to be SUS304 for weather exposed area, and brass or white acryl resin for other space.

6-2 Workmanship

All workmanship concerning the construction of the Vessel to be of the Builder's current standard practice, which has been approved by the Classification Society where required.

Prefabricated outfitting work on the construction blocks prior to block erection, which is the Builder's usual practice, to be adopted as far as possible.

Irrespective of the above descriptions, the Builder's improved up-to-date shipbuilding practice and workmanship at the time of construction of the Vessel to be applied.

6-3 Subcontractor and Manufacturer

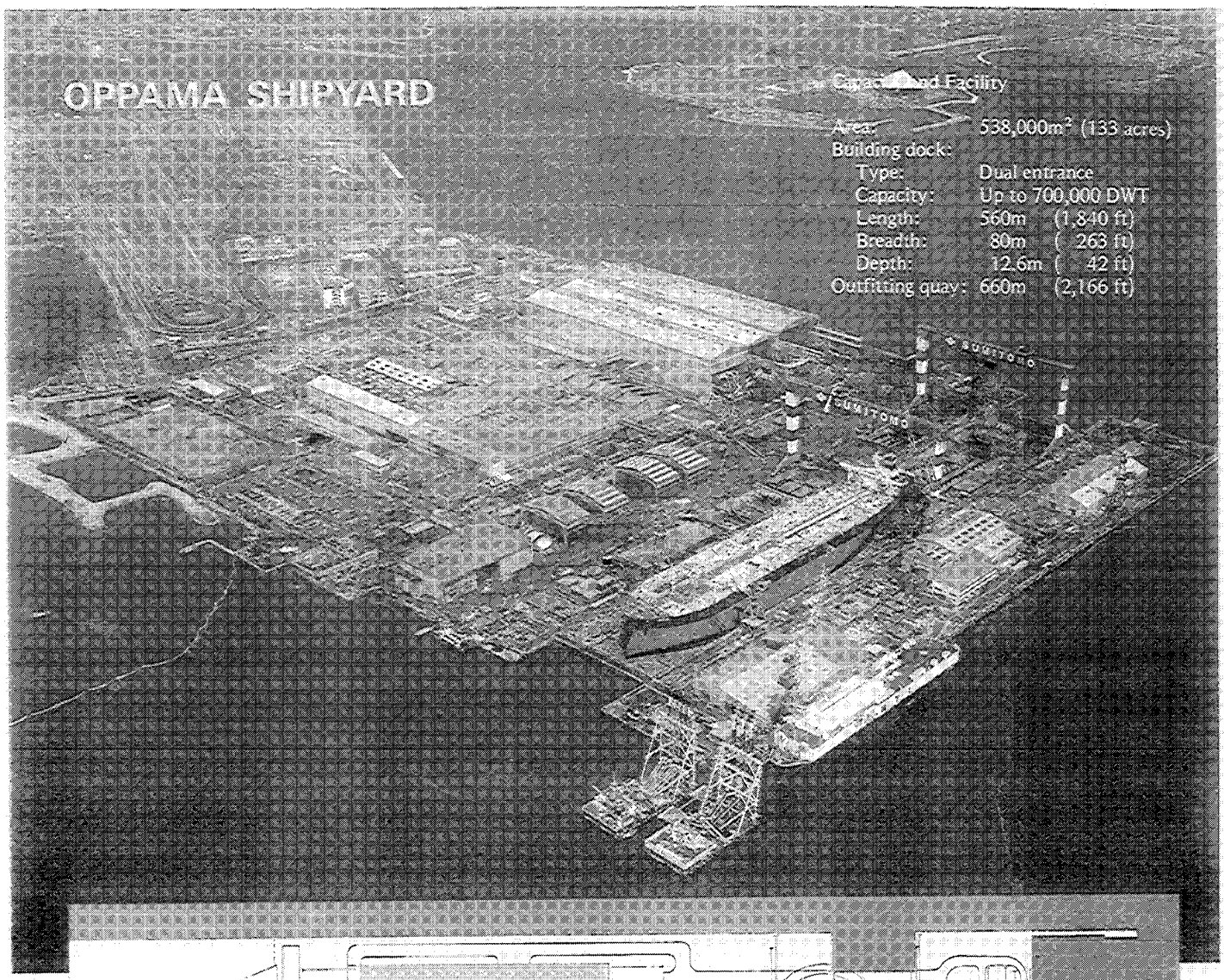
The Builder may employ subcontractors for execution of the building work of the Vessel and may purchase the materials, machinery, apparatus and equipment from the manufacturers including parts manufacturers under the responsibility of the Builder.

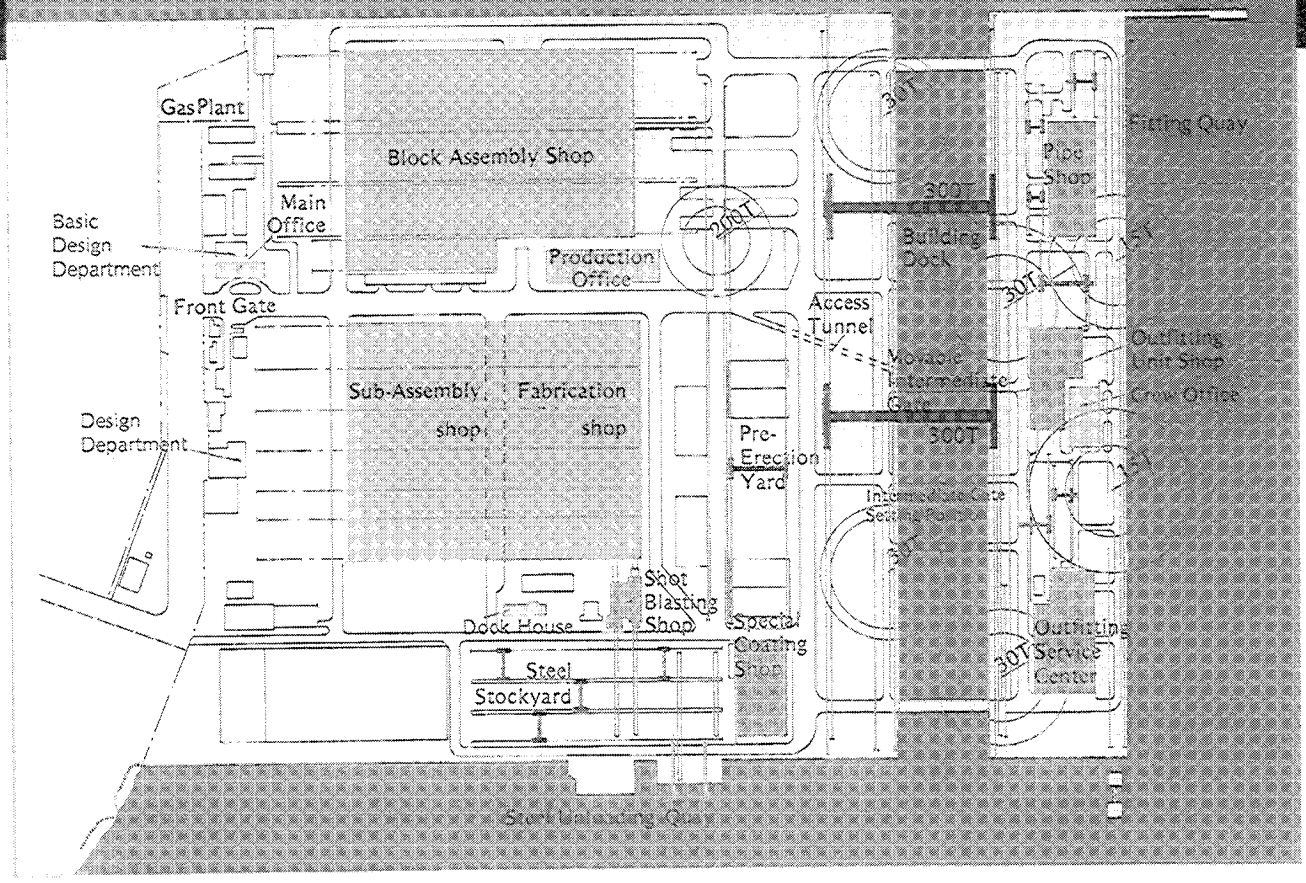
The Builder to submit the list of manufacturers for major items, such as machinery, windlass, winch, paint, etc. for the Owner's information in due time.

Materials, spare parts and tools of the machinery, apparatus, equipment, etc. to be of the Builder's and the manufacturers' standard, as approved by the Classification Society and other regulatory bodies concerned where required.

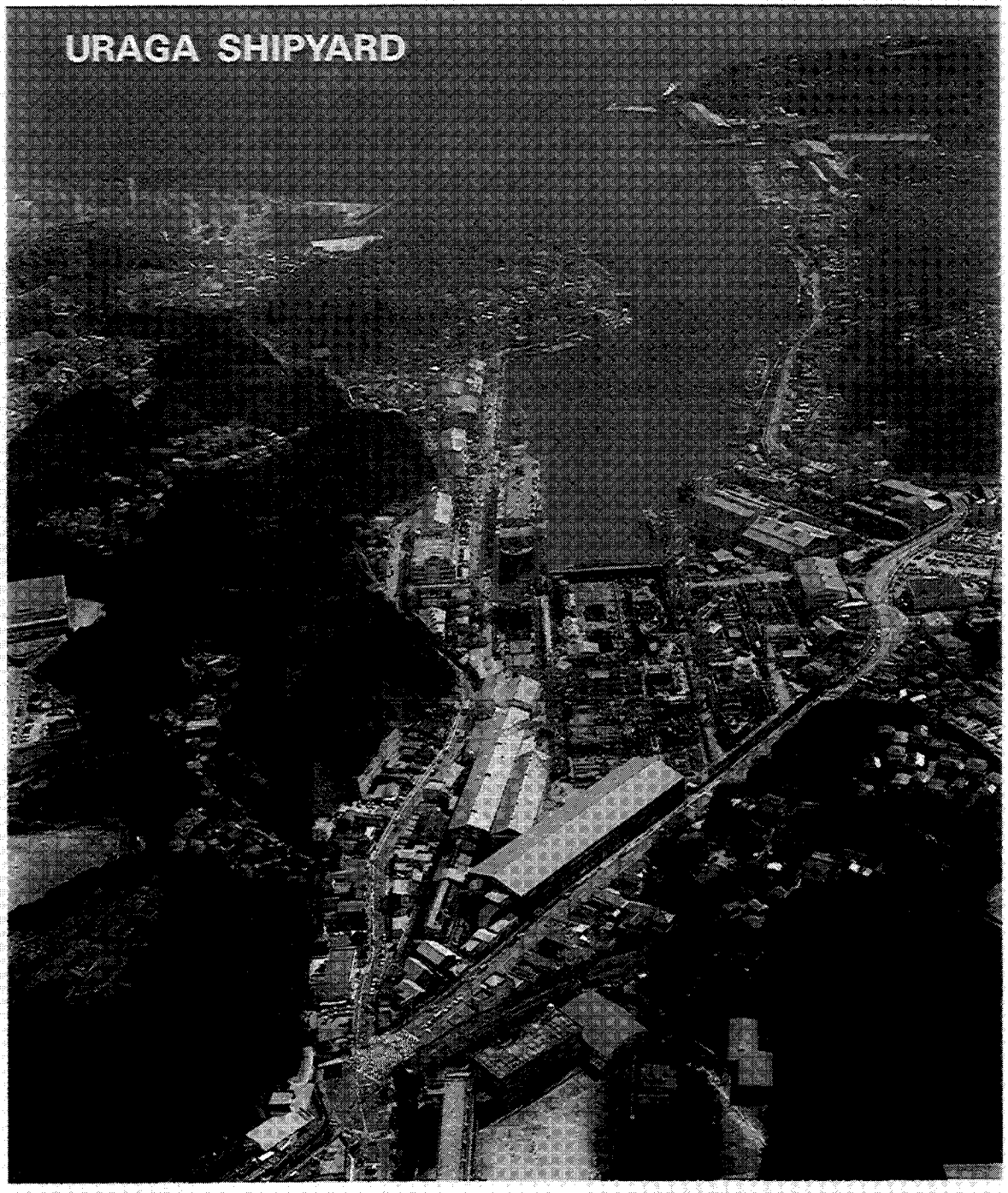
ENCLOSURE (2)

- **SHI Shipyard Aerial Photos, Layouts and Organizational Information**


OPPAMA SHIPYARD
Capacity and Facility
Area: 538,000m² (133 acres)
Building dock:
Type: Dual entrance
Capacity: Up to 700,000 DWT
Length: 560m (1,840 ft)
Breadth: 80m (263 ft)
Depth: 12.6m (42 ft)
Outfitting quay: 660m (2,166 ft)


Gas Plant
Block Assembly Shop
Main Office
Basic Design Department
Production Office
200T
Front Gate
Access Tunnel
Sub-Assembly shop
Fabrication shop
Design Department
Pre-Erection Yard
Shot Blasting Shop
Special Coating Shop
Dock House
Steel Stockyard
Building Dock
300T
Pipe Shop
Fitting Quay
Outfitting Unit Shop
Crew Office
Outfitting Service Center

URAGA SHIPYARD



Uraga Shipyard is located 5 miles south of Oppama Shipyard and is at the mouth of Tokyo Bay. Uraga has been the main yard since its establishment in 1897.

Uraga is capable of constructing any type of vessel up to about 30,000 DWT on its building berth and mainly constructs special-purpose vessels such as naval ships and liquid gas carriers using advanced technology.

Ship-repair activity is also performed in Uraga, utilizing two drydocks which can accommodate vessels up to 12,500 DWT.

	Length	Breadth	Draft (max.)
Building Berth	200.0m	27.8m	—
No.1 Repair Dock	171.1m	19.5m	5.9m
No.2 Repair Dock	143.0m	16.6m	6.8m

Chronological History

1888
Started as machine shop of Besshi Mining Co., Ltd.

1897
Establishment of Uraga Dock Co., Ltd.

1934
Establishment of Sumitomo Machine Manufacturing Co., Ltd.

1940
Company name changed to Sumitomo Machinery Co., Ltd.

1945
Company name changed to Shikoku Machinery Co., Ltd.

1952
Company name revived to Sumitomo Machinery Co., Ltd.

1957
Establishment of New York office.

1959
Expansion of shipbuilding dock completed.
Establishment of Nagoya Works.

1962
Establishment of Hiratsuka Research Laboratory.
Amalgamation of Uraga Tamashima Diesel Industries, Ltd. with Uraga Heavy Industries, Ltd.

1964
Establishment of London office.

1965
Establishment of Chiba Works

1966
Establishment of Sumitomo Machinery Corporation of America.

1969
Amalgamation of Sumitomo Machinery Co., Ltd. and Uraga Heavy Industries, Ltd., under company name of Sumitomo Heavy Industries, Ltd.

1970
Ground-breaking ceremony of Oppama Shipyard.

1971
Completion of world's largest forging press. (11,000 tons)

1972
Inauguration of Oppama Shipyard.
Received order for steel structures for the Shinjuku Sumitomo Building.
Inauguration of Toyo Works.
Completed the first cyclotron

1974
Capital participation in Cyclo Getriebebau Lorenz Braren GmbH.
Establishment of Sumitomo Maquinas Pesadas do Brasil Ltds.
Completion of LASH feeder barge, with blast & de-blast system.
Received order for off-shore drilling rig

1975
Inauguration of Systems Research Laboratory.
Visit to the Oppama Shipyard by His Highness Duke of Edinburgh.
Launching of Japan's first ULCC (420,00 DWT oil tanker).

1976
Received turnkey order from Iran for port cargo handling facilities.
Received order from Dubai for mammoth desalination plant.

1977
Concluded Technical License for offset rotary printing machines.

1978
Issued first variable interest Euro-Asia bonds of U S.$25 million.

1979
Completed water tank for testing multi-functions at Hiratsuka Research Laboratory.
Establishment of Singapore office.

1980
Completed development of small cyclotron for therapeutic research.
Launching of Japan's first gas turbine naval escort ship "HATSUYUKI".

1981
Completion of world's largest 16,000 ton forging press.
Received order from Qatar for mammoth desalination plant.

1982
Completion of world's first "Voice Control" ship "KINOKAWA MARU".
Received order for Japan's first original design schooner "NIPPON MARU", for training merchant mariners.
Received turnkey order for first carrier system for shipment to U.S.A.
With the amalgamation of Nittoku Metal Industries, Ltd., the Precision Products Group was formed.
Received order for world's largest hot former for manufacturing FF cars.

1983
Received order for world's largest offshore platform.

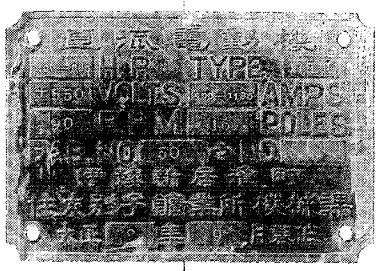
1984
Inauguration of schooner "NIPPON MARU".

1985
Received order for world's largest 2,000 T/H continuous unloader.
Inauguration of high performance wind testing tunnel at Hiratsuka Research Laboratory.
Delivered the "HORNET 500", the unmanned underwater probing vessel.

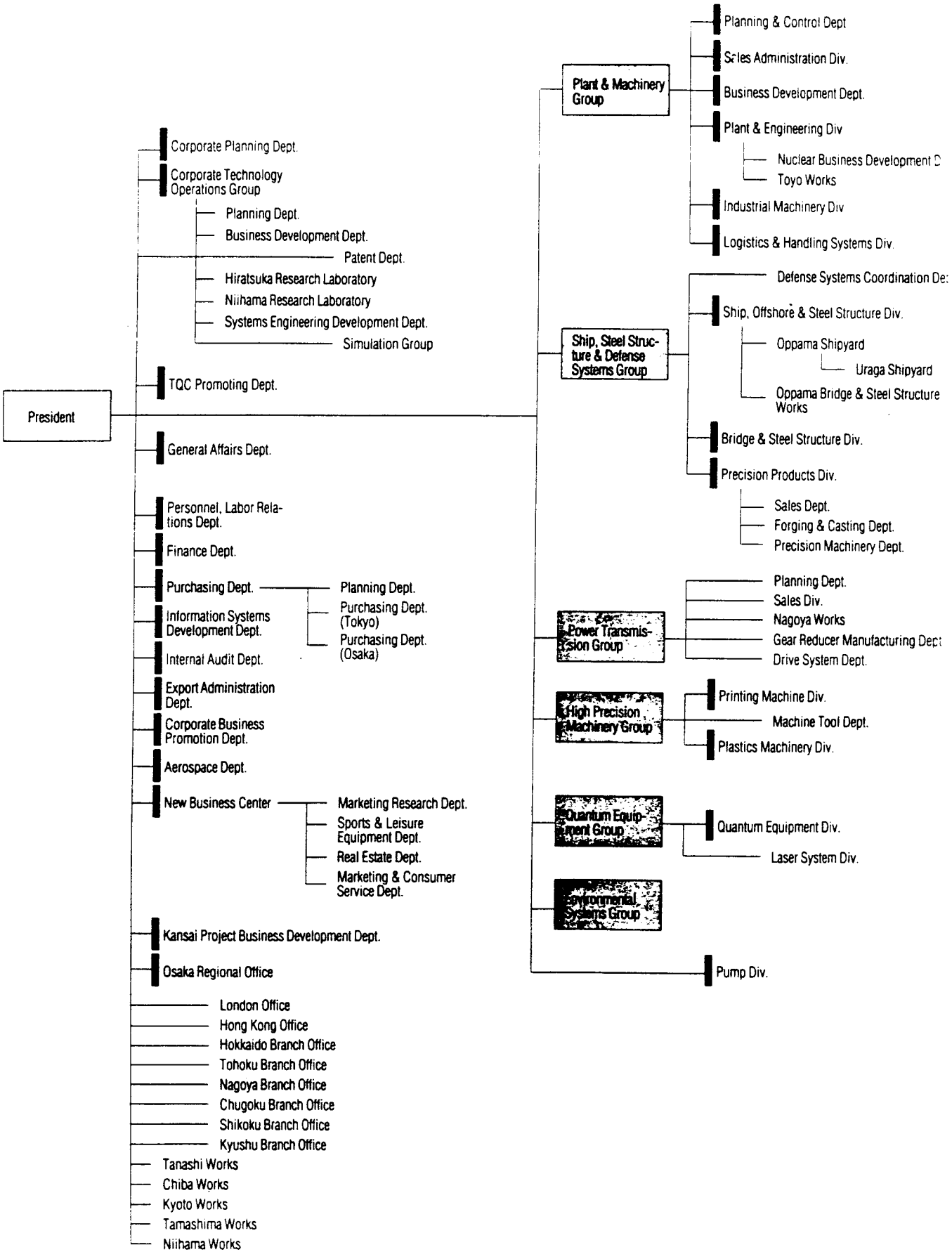
1986
Acquisition of Radiation Dynamics inc., accelerator manufacturer of U.S.
Entered business of electron beam accelerators.

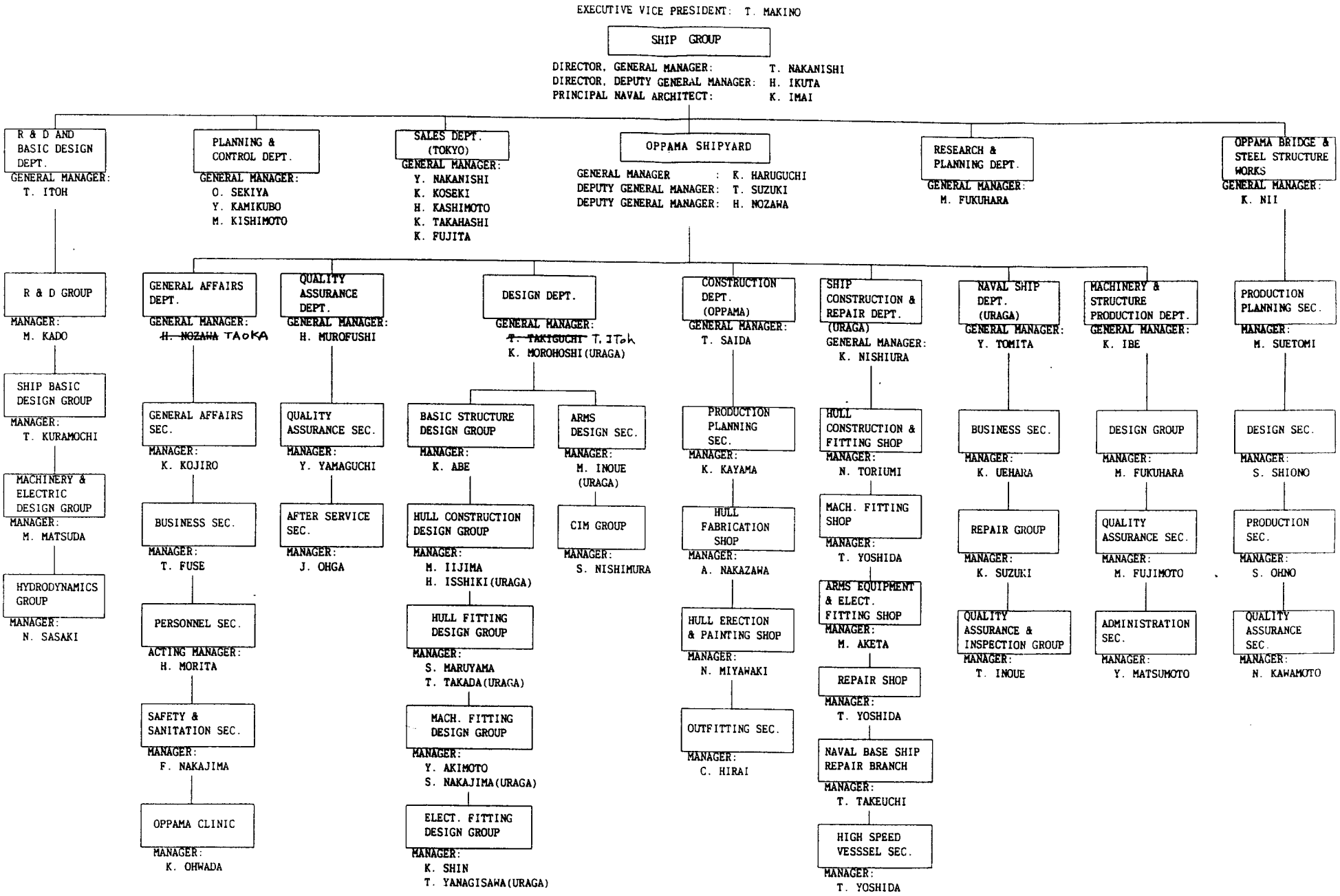
1987
Delivery of first Japanese car carrier for registry under U.S. flag.
Commenced construction of super small SOR ring.
Received order from Osaka University for one of the world's largest ring cyclotron.

1988
Delivered to the Space & Science Laboratory, the world's first superfluid helium transfer unit.
Inauguration of a large aluminum alloy precision casting plant at the Tanashi Works.
Inauguration of a new production base in the U.S.A. for power transmission equipment.



Organizational Structure

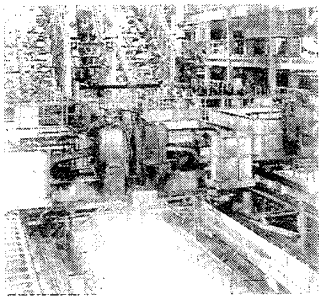



EXECUTIVE VICE PRESIDENT: T. MAKINO
SHIP GROUP
DIRECTOR, GENERAL MANAGER: T. NAKANISHI
DIRECTOR, DEPUTY GENERAL MANAGER: H. IKUTA
PRINCIPAL NAVAL ARCHITECT: K. IMAI
R & D AND BASIC DESIGN DEPT.
GENERAL MANAGER: T. ITOH
PLANNING & CONTROL DEPT.
GENERAL MANAGER: O. SEKIYA Y. KAMIKUBO M. KISHIMOTO
SALES DEPT. (TOKYO)
GENERAL MANAGER: Y. NAKANISHI K. KOSEKI H. KASHIMOTO K. TAKAHASHI K. FUJITA
OPPAMA SHIPYARD
GENERAL MANAGER : K. HARUGUCHI
DEPUTY GENERAL MANAGER: T. SUZUKI
DEPUTY GENERAL MANAGER: H. NOZAWA
RESEARCH & PLANNING DEPT.
GENERAL MANAGER: M. FUKUHARA
OPPAMA BRIDGE & STEEL STRUCTURE WORKS
GENERAL MANAGER: K. NII
R & D GROUP
MANAGER: M. KADO
SHIP BASIC DESIGN GROUP
MANAGER: T. KURAMOCHI
MACHINERY & ELECTRIC DESIGN GROUP
MANAGER: M. MATSUDA
HYDRODYNAMICS GROUP
MANAGER: N. SASAKI
GENERAL AFFAIRS DEPT.
GENERAL MANAGER: H. NOZAWA TAOKA
QUALITY ASSURANCE DEPT.
GENERAL MANAGER: H. MUROFUSHI
DESIGN DEPT.
GENERAL MANAGER: T. TAKIGUCHI T. ITOH K. MOROHOSHI (URAGA)
CONSTRUCTION DEPT. (OPPAMA)
GENERAL MANAGER: T. SAIDA
SHIP CONSTRUCTION & REPAIR DEPT. (URAGA)
GENERAL MANAGER: K. NISHIURA
NAVAL SHIP DEPT. (URAGA)
GENERAL MANAGER: Y. TOMITA
MACHINERY & STRUCTURE PRODUCTION DEPT.
GENERAL MANAGER: K. IBE
PRODUCTION PLANNING SEC.
MANAGER: M. SUETOMI
GENERAL AFFAIRS SEC.
MANAGER: K. KOJIRO
BUSINESS SEC.
MANAGER: T. FUSE
PERSONNEL SEC.
ACTING MANAGER: H. MORITA
SAFETY & SANITATION SEC.
MANAGER: F. NAKAJIMA
OPPAMA CLINIC
MANAGER: K. OHWADA
QUALITY ASSURANCE SEC.
MANAGER: Y. YAMAGUCHI
AFTER SERVICE SEC.
MANAGER: J. OHGA
BASIC STRUCTURE DESIGN GROUP
MANAGER: K. ABE
HULL CONSTRUCTION DESIGN GROUP
MANAGER: M. IIJIMA H. ISSHIKI (URAGA)
HULL FITTING DESIGN GROUP
MANAGER: S. MARUYAMA T. TAKADA (URAGA)
MACH. FITTING DESIGN GROUP
MANAGER: Y. AKIMOTO S. NAKAJIMA (URAGA)
ELECT. FITTING DESIGN GROUP
MANAGER: K. SHIN T. YANAGISAWA (URAGA)
ARMS DESIGN SEC.
MANAGER: M. INOUE (URAGA)
CIM GROUP
MANAGER: S. NISHIMURA
PRODUCTION PLANNING SEC.
MANAGER: K. KAYAMA
HULL FABRICATION SHOP
MANAGER: A. NAKAZAWA
HULL ERECTION & PAINTING SHOP
MANAGER: N. MIYAWAKI
OUTFITTING SEC.
MANAGER: C. HIRAI
HULL CONSTRUCTION & FITTING SHOP
MANAGER: N. TORIUMI
MACH. FITTING SHOP
MANAGER: T. YOSHIDA
ARMS EQUIPMENT & ELECT. FITTING SHOP
MANAGER: M. AKETA
REPAIR SHOP
MANAGER: T. YOSHIDA
NAVAL BASE SHIP REPAIR BRANCH
MANAGER: T. TAKEUCHI
HIGH SPEED VESSSEL SEC.
MANAGER: T. YOSHIDA
BUSINESS SEC.
MANAGER: K. UEHARA
REPAIR GROUP
MANAGER: K. SUZUKI
QUALITY ASSURANCE & INSPECTION GROUP
MANAGER: T. INOUE
DESIGN GROUP
MANAGER: M. FUKUHARA
QUALITY ASSURANCE SEC.
MANAGER: M. FUJIMOTO
ADMINISTRATION SEC.
MANAGER: Y. MATSUMOTO
DESIGN SEC.
MANAGER: S. SHIONO
PRODUCTION SEC.
MANAGER: S. OHNO
QUALITY ASSURANCE SEC.
MANAGER: N. KAWAMOTO

Plant & Machinery Group

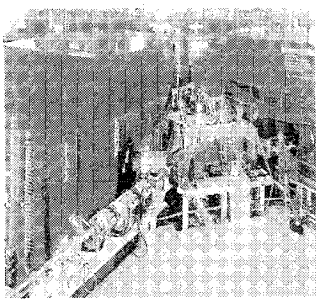
Industrial Machinery Division

Iron and steel manufacturing
and nonferrous
metals manufacturing
machines
Forging machines
Resin forming machines
Composite forming machines



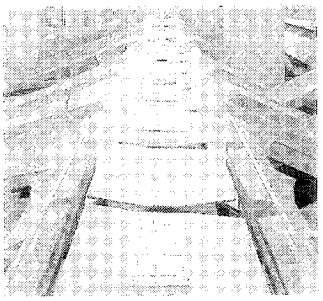
Quantum Equipment Center

Ion accelerators
Electron beam
accelerators
Magnets



Logistics & Handling Systems Division

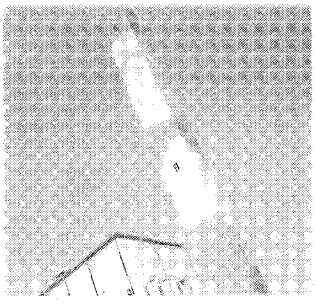
Material handling
equipment
Logistics and
handling systems
Automated parking systems
and Moving sidewalk



Engineering & Environment Group

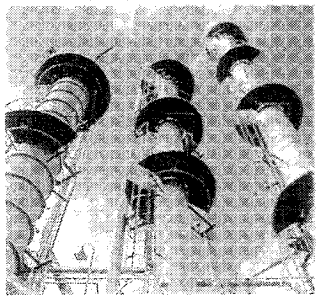
Environment Division

Municipal water
treatment plants
Waste treatment plants
Industrial water/
waste water
treatment plants
Production/high-
separation equipment
Maintenance/control
technology and chemicals



Plant & Engineering Division

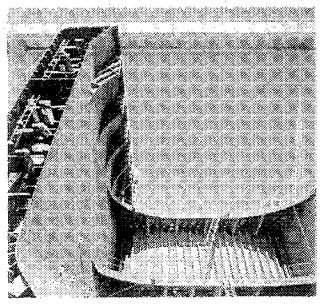
Chemical process
equipment and plant
Pulp and paper
manufacturing
machinery
Air pollution
control equipment
Nuclear power-
related equipment
Circulating fluidized
bed boiler system



Ship, Steel Structure & Defense System Group

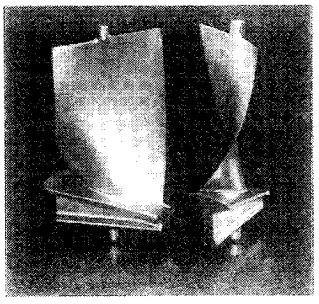
Ship, Offshore & Steel Structure Division

Ships
Offshore
structures
Marine
development
equipment
Other machines



Precision Products Division

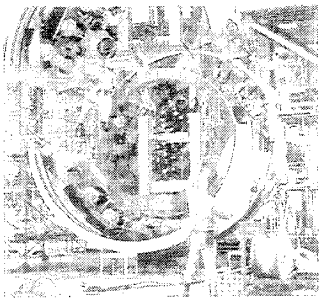
Fine materials
Cryogenic
equipment
Defense equipment
Precision products



Steel Structure & Process Equipment Group

Bridge & Steel Structure Division

Bridges
Water gates and special structures
Mechanical shield machines



Toyo Division

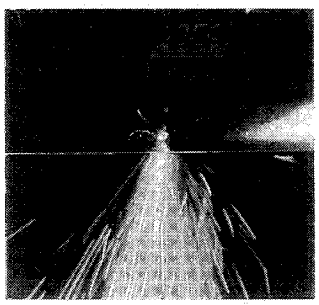
Pressure vessels & reactors
Mixing reactors
Cooling systems/ Autoclaves
Bridges/ steel structures



High-Precision Machinery Group

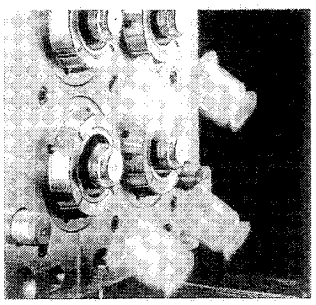
Laser System Division

Laser processing systems



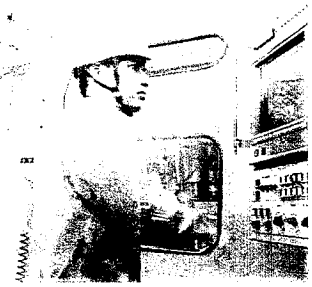
Plastics Machinery Division

Plastic injection molding machines
Ceramic injection-molding machines
Film converting machines
Extrusion laminator
Semiconductor encapsulation equipment
Molds for plastics
Plastic processing systems



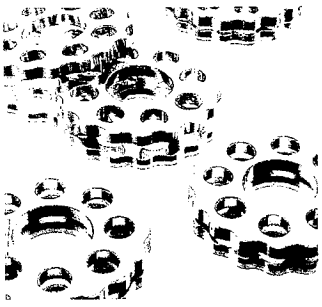
Okayama Machinery Division

Paper-making machinery
Machine tools
General industrial machinery



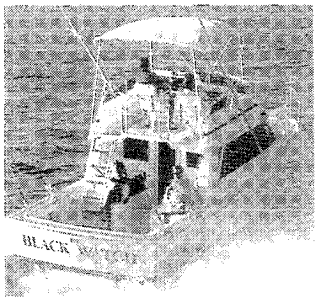
Power Transmission & Controls Group

Power transmission equipment
Electrical equipment



New Business Center

Marine and leisure equipment
Marketing and consumer services
Real estate development
Consultation



ENCLOSURE (3)

- **Handout Information on The Use of Computers**

IV-3 The use of Computer

IV-3-1 General Configuration

Computer network of our company is illustrated in Fig. IV-7.
Main Host Computer is located in Tokyo Computer Center and local host computers are also located in each work and shipyard as listed in the above figure.
Programs and data in each central and local host computer can be used commonly each other through every terminal.

IV-3-2 Computer Facilities in Oppama Shipyard

Computer facilities in Oppama Shipyard are as follows.

A) Computer Hardware

Local Host Computer, Time Sharing System (TSS) terminal and Graphic terminal are mainly used for Computer Aided Design and Manufacturing (CAD/CAM).
Mini-super computer, Engineering Work Station (EWS) and Personal Computer are mainly used for Computer Aided Engineering (CAE) and Program Development.

Mini-super computer is connected with Local Host Computer and all EWS in Oppama Shipyard by network.

1) Local Host Computer IBM 3090-200 1 set

~~2) Mini-Super Computer CONVEX-C210 1 set~~

3) Engineering Work Station 25 ~~15~~ sets

HP9000 715/80~100
~~SGI IRIS 4D-210GTX~~
IBM POWER STATION
SUN SPARC STATION
X-TERMINAL
etc.

4) Graphic terminal 66 sets

IBM 3277-GA
IBM 5080 series
IBM 5086
KANEMATSU ELECTRONICS DS7080

5) TSS terminal and Personal Computer 135 sets

IBM PS55 series
NEC PC9801 series
NEC N5200-M16
TOSHIBA J3100
etc.

6) Plotter

TOYO DENKI DRASTEM 8700 online electrostatic plotter	3 sets
TOYO DENKI DRASTEM 8630 online leser plotter	1 set
TOYO DENKI DRASTEM 8400 network leser plotter	1 set

B) Computer Software

Typical computer softwares available in Oppama shipyard are listed below.

1) Computer Aided Engineering System

a. Hull basic design

Integrated hull lines generating system
Synthetic calculation (capacity, trim and stability, longitudinal strength, intact and damaged stability, etc)
etc.

b. Fluid Analysis

Propulsive performance calculation
(resistance, self propulsion factors, 3-D boundary layers, etc.)
Propeller design and analysis
(propeller chracteristics, propeller cavitation, CRP, etc)
Seakeeping calculation combined with stress analysis
Maneuverability calculation
etc.

c. Structural Analysis

MSC/NASTRAN for Finite Element Method (FEM) analysis
(Static analysis, Viblation analysis, Elastic/Plastic analysis
Transient analysis, Heat transfer analysis, Fluid dynamics
analysis, etc.)
ICES/STRUDL for FEM analysis
Seakeeping response analysis program
Fatigue analysis program
Response analysis program for offshore structure
Buckling evaluation program
I-DEAS FEM analysis
I-DEAS PRE/POST processor
DNV/PILOT for Dnv classification rule calculation
LR.FLUIDS for sloshing analysis of tank
etc.

d. Application Program for Outfitting

Piping pressure loss
Duct pressure loss
Tank heating
Diameter of air pipes
Windlass capacity
HVAC capacity
Noise level in living quarter
Radiator capacity

Capacity of water service system
Size of HVAC duct
Shaft alignment calculation (nonlinear spring system)
Bearing offset calculation of shafting
Longitudinal vibration analysis of shafting
Lateral vibration analysis of shafting (considering oil film damping)
Propeller strength analysis
Propeller weight and moment of inertia calculation
Short circuit current
Illumination level for deck part
etc.

2) Computer Aided Design System

Graphic landing system for seam longitudinal stiffener
Basic hull section generating program
CADAM (Computer Augmented Design and Manufacturing) system
CADAM 3D-Piping system
Several MACRO programs for drawing
etc.

Now, 70% of drawings are drawn by the CADAM system

3) Computer Aided Manufacturing System

Inner hull pieces generating system
Shell plate expansion program
Longitudinal stiffner expansion program
Frame stiffener expansion program
Pipe pieces generating system
Interractive plate pieces nesting system
Numerical controll program for plate cutting
Automated fablication system for shapes and flat bars
Jig hight calculation program for assembly
Welding system for sub-assembly
Welding system for block assembly
etc.

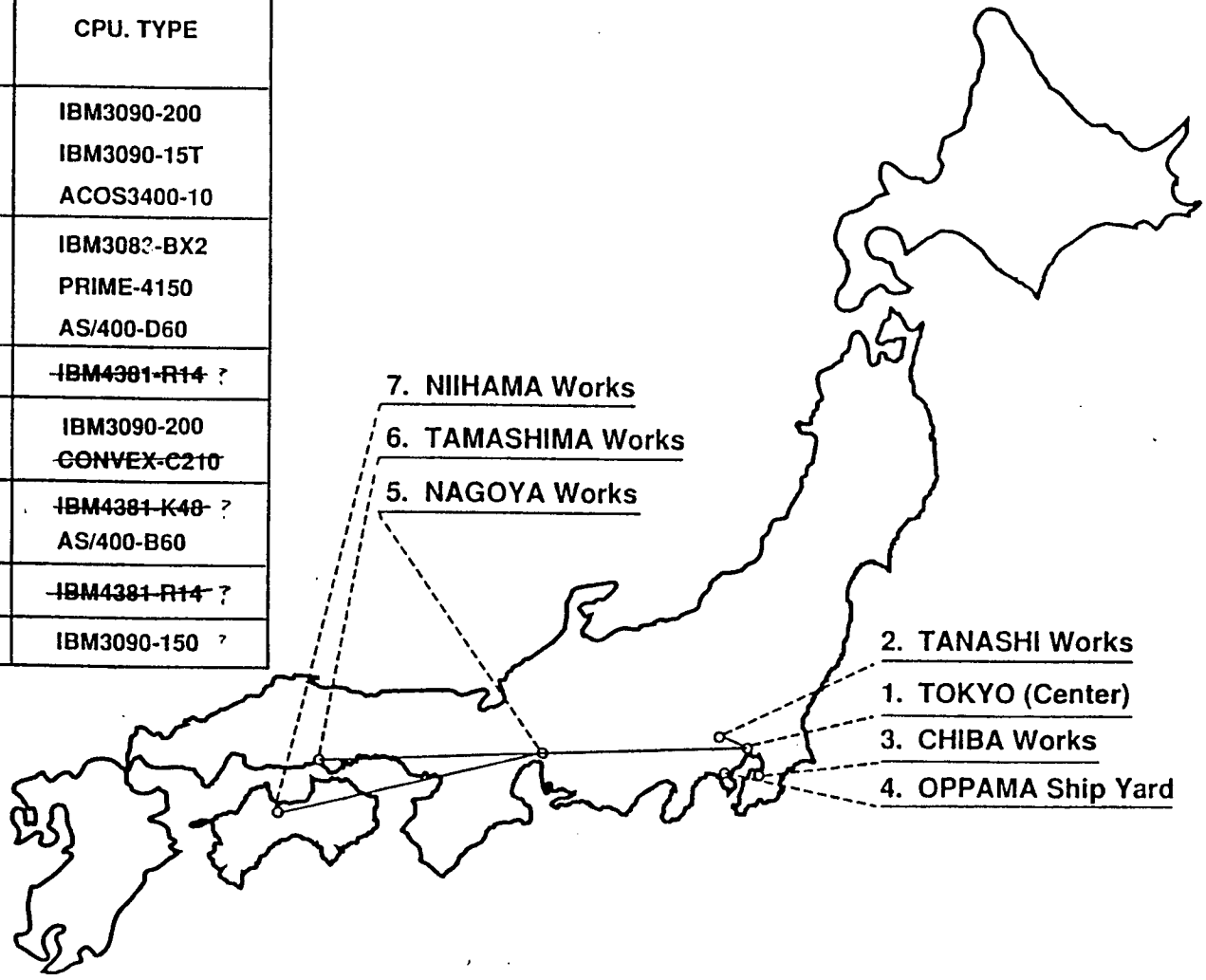
4) Others

Material purchasing control cystem
Elecl ric cable total system
etc.

FIG. IV-7 COMPUTER NETWORK

Sumitomo Heavy Industries, Ltd.

NO.	PLACE	CPU. TYPE
1	TOKYO (CENTER)	IBM3090-200 IBM3090-15T ACOS3400-10
2	TANASHI WORKS	IBM3083-BX2 PRIME-4150 AS/400-D60
3	CHIBA WORKS	~~IBM4381-R14~~ ?
4	OPPAMA SHIPYARD	IBM3090-200 ~~CONVEX-C210~~
5	NAGOYA WORKS	~~IBM4381-K48~~ ? AS/400-B60
6	TAMASHIMA WORK	~~IBM4381-R14~~ ?
7	NIIHAMA WORKS	IBM3090-150 ?



ENCLOSURE (4)

- **NSRP SP6 Project 6-94-1, World Class Shipbuilding Standards, Questions and Responses from SHI's Oppama Shipyard, Yokosuka City, Japan**

NSRP SP6 PROJECT 6-94-1

WORLD CLASS SHIPBUILDING STANDARDS

QUESTIONS AND RESPONSES FROM

SUMITOMO HEAVY INDUSTRIES, Ltd.

OPPAMA SHIPYARD, YOKOSUKA, JAPAN

December 4-8, 1995

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

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NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

The following listing of standards is offered to provide the reader with the type of standard, country of origin and their associated abbreviations, some of which are addressed in this document. Refer to ASTM Standard Guide Listing - ASTM F1547-94, Relevant Standards and Publications for Commercial Shipbuilding, for additional listing of applicable standards.

CLASSIFICATION SOCIETIES

Lloyds Register of shipping (Lloyds) - Great Britain
American Bureau of Shipping (ABS) - United States
Det Norske Veritas (DNV) - Norway
Germaniser Lloyds - Germany
Bureau Veritas - France

REGULATORY AUTHORITIES

American Bureau of Shipping
United States Coast Guard
United States Public Health

EUROPEAN STANDARDS

[Under development]

INTERNATIONAL STANDARDS ORGANIZATION

International Standards Organization (ISO) -

NATIONAL STANDARDS

Deutsches Institute furNormung (DIN) - Germany
American National Standards Institute (ANSI)
British Standards Institute (BSI)
Japan Industry Standard (JIS)
Korea Industry Standard (KIS)

ASSOCIATION STANDARDS

Danske Vaerfters Standardiseringsudvalg (DVS) - Denmark

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
A1. IDENTIFICATION OF PREDOMINANT STANDARDS	
A1.1 Is an index of Standards maintained?	Yes. Many standards and practices are applied for commercial ship design/procurement/construction.
A1.2 What is the extent of International, Domestic & Local Shipyard Standards application?	JIS is the first standard of choice , supplemented by internally developed standards. All standards of record are applied to all ship designs, as applicable.
A2. POPULATION STUDY OF SHIPYARD, TYPES OF COMMERCIAL VESSELS AND ENVIRONMENT EVALUATION QUESTIONS	
A2.1 What has led the shipyard to its current market segment?	Double hull tanker (AFRA Max, VLCC). Panamax bulk carrier, PTCT
A2.2 What type of ships has the shipyard built over the last 25 years?	Many types. Refer to Attachment (1)
What are the annual tonnage trends?	Many types. Refer to Attachment (1)
What are the annual ship completions?	Refer to Attachment (1)
A2.3 Do you carry out ship construction and repair?	Yes
What is the repair to new construction ratio?	New construction - 85%; repair - 15%.
What is the ratio of Commercial to Navy repair work?	Japanese Navy, US Navy, Japanese Government Including local government) ships repair - 90%. Commercial ships repair - 10%.
What is the extent of modularization on new construction and repair work?	100% - new construction. As required on repair work. Oppama Shipyard: Construction dept includes repair planning group and workers are common - new construction and repair. Uraga shipyard: Ship construction dept includes repair shop.
How is modularization applied and integrated on new construction?	above
What is the extent of pre-outfitting of blocks prior to erection?	~ 40%. [total manhour basis - higher at launch ~ 80%].
A2.4 How many ships are currently under construction?	
What is the schedule for current and future business?	7 ships - 1995. Oil tanker, VLCC, Bulk Carrier, work vessels and patrol craft. 9 ships - 1996. VLCC, Bulk carrier, PCTC's, Patrol Craft. Refer to Attachment (1)
How well are schedules met?	Within 1-2 days.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
How does standardization affect construction and schedules?	To minimize the schedule from contract to delivery.
A2.5 What is the size and composition of the current labor force?	
What are the average annual total personnel numbers?	Less than 1000 workers in both yards - including bridge work and subcontractors (in yard); 1300 including designers and administration and ≤ 2000 total designers, workers, administration, subcontractors (in house and outside).
Hourly	Basically all personnel are considered salaried
Salaried	See above.
Subcontracted	No Response
How has the level and composition of personnel changed over the last 10 years?	~ 15%, decrease by 2 major reductions in manpower.
What has influenced composition of personnel the most?	No Response
What are the general experience levels of personnel at the yard?	No Response
What is the average employment years of personnel at the yard?	No Response
Hourly	No Response
Salaried	No Response
Subcontracted	No Response
What are the general experience levels of personnel at the yard?	~ 20 years
What is the average employment years of personnel at the yard?	~ 20 years
How has the experience level of personnel changed over the last 10 years?	IHI has been downsizing their shipyard divisions by relocating (majority) of people to other IHI divisions. Insignificant new hires under downsizing conditions. Resulting experience levels equal or greater than 20-25 years

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
A2.6 What do you believe is the market position for the worldwide shipbuilding industry?	Opening but saturated markets.
A2.7 Who are this shipyards major competitors?	Japanese and Korean major shipyards.
What is your share of the market segment?	SHI has 2-3% of the world market for tonnage. < 10% of the VLCC market. Total market share is 42% for Japan's shipyards.
What are the current market risk areas?	Currency, Japanese yen vs. US dollar
What are the economic effects?	G-7 countries and developing Asian countries' economic effects are very large
A3. SHIPYARD/CLASS SOCIETY STANDARDS AND POPULATION STUDY These questions explore the standards bases that are available to and used in preference by the Shipyard and Classification Societies.	
A3.1 With your current customer base, which Class Societies are you presently working with?	ABS, DNV, NK
What is your Class Society of choice?	No special choice
To what extent do you use ISO standards?	Noise and vibration level, hull construction, etc..
To what extent do you augment Class Society requirements with yard standards (basic proportion only)?	Class society requirement is basically the minimum requirement. Each yard's standards have to be reviewed/updated by each shipyard.
How do you accommodate different customers needs with respect to Class Societies and Standards applications?	Each design section summarizes the customer's special requirement.
Do you use a Master set of standards and make minor alterations as necessary?	Yes. Minor changes as customer dictates (at a cost unless in original contract).
Are standards sets based on specific, and limited range of, Customers/Class Societies?	No
How are standards and standardization presented to the customer?	At drawing approval stage only.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
How are standards and standardization incorporated in ship specifications?	In ship specifications, only applied standards names are provided.
A3.2 How do you access other standards?	
What is the extent and scope of the Shipyard library?	SHI standards - (1) SKU for fittings, (2) SHS for hull and (3) Construction Standards (basically JSQS, Japanese Shipbuilding Quality Standards) for shops, - are the principal standards developed and used by the shipyard.
What is the format of Shipyard Standards?	Refer to Attachment (2).
Does a Shipyard Standards Manual exist and what does it contain?	Each design section maintains their own standard volumes. SHI has over 10,000 SKU, SKS and production standards.
A3.3 Does the Shipyard library have a standards equivalency cross reference system.	No Response
A3.4 To what extent are specific equipment's and standards pre-approved for use?	No Response
Are these standards pre-approved?	Shipyard standards are not pre-approved. Each equipment manufacturer has their standard design which meets latest regulatory requirements.
By Regulatory Authorities?	N/A
By Class Societies?	N/A
Are standards contract specific?	No - not as a rule.
A3.5 How do you negotiate requirements with the Customer?	No Response
Who negotiates the standard?	At the basic design stage - Hull, Electrical, Machinery Managers. At the detail design stage, Hull Construction, Hull Fitting, Electrical and Machinery Design Managers. At the production stage, Production Planning Group Manager and QA Group Manager.
How does the Standards Group integrate with the negotiation process?	Above, and only in the case of establishing a new standard.

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RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
A4. ORGANIZATION AND BENEFITS The following questions concern the existence of the standards group and are based on a review of the shipyard organization.	
A4.1 Why is the Standards Group positioned in the organization the way it is?	To ensure best possible technical standards, SHI assigns a small group of cognizant people within each technical discipline and QA Department, to develop and maintain their respective standards.
Who does the Standards Group report to?	To their respective discipline or section manager
Who reports to the Standards Group?	as assigned within each discipline
Who are the Standards Group primary customers?	Engineering
A4.2 When was the Standards Group formed and why.	No Response
How did the Standards Group develop and what is the group's history?	More than a 30 year history.
Where is the Standards Group physically located?	Within the various engineering disciplines, production and QA depts.
What is the charter of the Standards Group?	To maintain design and production standards.
What is the short and long term goal of the Standards Group?	To reduce costs, improve productivity and quality and meet latest requirements.
A4.3 What are the internal responsibilities of the Standards Group?	The General Manager of each Department and acting Section Managers are responsible for their own standards.
A4.4 What is the external awareness of the Standards Group to the world class standards?	No Response
Meeting standards?	SHI standards are well established and they are maintained to satisfy all requirements.
Maintaining standards?	See above
Developing standards?	New standards are developed as needs dictate.
What is the Standards Group accessibility to National and International standards?	Design at SHI based principally on JIS unless customer requests otherwise.

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
A4.5 What is the structure of the Standards Group/Committees?	
What are the personnel capabilities, skills and educational levels?	SKU Group has sufficient experience in outfit and component design. Construction Standards Technology has over 10 years of welding, material, painting and etc. experience.
What is the cycle of personnel to and from the Standards Group?	SKU standards - 10 years. Construction Standards - 5 years.
What are the specialties of the Standards Group personnel?	Mechanical and Marine design.
What is the supervisory level required for the Standards Group?	Marine Engineer.
What supplementary training is offered/required for the Standards Group?	No Response
What facilities are available to the Standards Group to expedite standards work (e.g., PC, Network system)?	SKU Standards has CADAM. Construction Standards has Hiratsuka Laboratory.
A4.6 How are shipyard standards developed?	
What is the standards development process?	New requirement - change of existing standards are a function of new material, new product requirement
How are the standards requirements evaluated?	By the user.
What is the approval process for stds?	Department Manager
How is shipyard feedback on standards requirements achieved?	Provided to the cognizant Engineering design, Production or QA department by the users.
How is vendor feedback on standards requirements achieved?	Vendors provide their new plan, (standard for equipment), to design department through the Purchasing department. Generally, vendors drawings approved to the latest requirements are submitted to SHI for review.
A4.7 How is the Standards Group perceived in the shipyard?	Standards use are so much engrained in every aspect of shipyard processes in Engineering, Procurement, QA/QC and Production that it is second nature to all users. They are important at every level - management and workers.
By upper management?	See above
By internal and external customers?	See above

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
What is the qualitative value of the Standards Group?	high
A5. STANDARDS DATA BASES	
A5.1 Are Class Society requirements and standards held in a data base?	Paper base only.
A5.2 What is the size and type of the data base?	N/A
A5.3 How is the data maintained and updated.	Manually
A5.4 Are National and International Standards held in the data base?	No
A6. PAPER BASED STANDARDS CONFIGURATION	
A6.1 What is the mechanism for distribution?	Design standards - SKU and SHS - are distributed to all sections of the Design, Production and QA/QC departments by an administrative standards group at the respective shipyards.
A6.2 What is the format of Standards and how are they processed?	Refer to Attachment (3)
A6.3 How are the standards tied to other engineering or production documents?	
Engineering Drawings?	SKU and SHS are attached in each drawing (related part only).
Ship Specifications?	JIS, etc. are specified in the Specification.
Production Plans?	See above
Check Lists?	No Response
A7. CAD BASED STANDARDS CONFIGURATION	
A7.1 What is the architecture of standards in cad?	CADAM System - 2D
A7.2 How are standards integrated with CAD based Engineering?	
Catalog data base	Within CAD
Catalog data base with vendor input and format?	No

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
Interface between Engineering CAD and standards data base?	no
A7.3 How are standards presented to the CAD operator?	
By default?	Automatically for all operational CAD systems (currently, hull construction only). Otherwise, standard application is done manually.
By selection from accessible data base?	No Response
By decision tree?	No Response
A7.4 How is the engineering bill of material used downstream?	
Material requirements planing (MRP or MAC-PAC)?	Systems are still under development. Construction material (Steel plate) input/output are handled on the computer network - separate system from the CAD systems.
Network system?	above
Manual system?	Material and CAM requirements are still lifted manually from the developing CAD systems or manually developed drawings and entered into SHI's computer network system (Host System) for nesting, NC data to production, material requirements to purchasing, and etc..
A7.5 How are standards distributed to Computer Aided Manufacturing - CAM)?	Hull construction (steel structure) standards are distributed for CAM through CAD.
A7.6 What standards are best incorporated into CAD/CAM?	No Response
What are the priorities?	As related to hull construction, configuration of longitudinal members, bracket stiffeners, bevel, slots, holes and etc..
Are those standards stable or dynamic?	Stable but recently dynamic.
Are the standards restrictive?	No Response

NSRP SP6 PROJECT 6-94-1, WORLD CLASS SHIPBUILDING STANDARDS
RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
B1. ORGANIZATION IDENTIFICATION	
B1.1 What is the approximate ratio of computers to engineers?	Hull construction design group - ~80% (CAD included). Each outfitting group - ~ 50% (CAD included). [Hull construction calculations are done primarily on PC's. Hydrostatics are done on CAD engineering workstations. Working to increase the number of CAD work stations and eliminating using PC Host System in three years.]
B1.2 Are there any subsidiary yards in the company?	No, however, some steel fabrication works, fittings manufacturing, NDT, and etc., are subcontracted.
B1.3 What is the level of Engineering done in house vs subcontracted?	Most engineering done in house; some engineering may be done by a subcontractor on a case basis and depending on his capabilities in related design.
B1.4 What types of engineering are typically subcontracted?	Detail design for piping, NC data and fitting detail design.
B1.5 What is the awareness/ familiarity of contract level designers /engineers in standards details?	No Response
B1.6 What is awareness/familiarity of production personnel in standards details?	SHS (hull construction standard) - high. SKS (outfitting standard) - medium, Foremen and Assistant Foremen are familiar with part (standard) numbers.
B1.7 How are make/buy decisions made? Why might they be changed? How are they changed?	Based on cost, productivity, capacity, etc.. Trade off analyzed by Hull Structure Planning. Recommendations made by Purchasing and Production.
B2. STANDARDS INTEGRATION	
B2.1 How are ship specifications categorized/indexed? Are Ship Work Breakdown Schedules (SWBS) used?	SWBS not used. They do use a simple breakdown approach that segregates machinery, hull, general and electric - into 3 levels. kept very simple and basic.
B2.2 How are system design requirements provided to engineers?	By Contract Specifications, memorandum of discussion with owner, basic design developed data and calculations and subsequent meetings with the Basic Design and Design Departments.
B2.3 Who is responsible for selection of standards on each contract?	General Manager of Basic Design Department.
B2.4 How are restirctions on use of standards identified?	No Response

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RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
B2.5 What type of Manufacturing Resource Planning (MRP) process do you use? This process identifies when quantities of each type of item required to build the ship is required in the shipyard.	Set by Planning. (SHI unfamiliar with "MRP" terminology.)
B2.6 How do engineers find standards?	No Response
B2.7 How do engineers/designers identify the components they want to use from the standards on their drawings?	SHI uses the same number for a part on a drawing as is used for the standard.
B2.8 How many contract unique standards does the shipyard have?	Very few.
B2.9 How are changes to the standards handled?	No Response
B2.10 How are standards imposed on sub-contractors?	Related standard is distributed to each subcontractor.
B2.11 How are planning issues handled for standard vs. non-standard parts?	No Response
B2.12 How are non-standard items identified to replace standard ones?	No Response
B2.13 How is non-conforming material handled? What amount of non-conforming material is delivered to the yard? How is this prevented?	Material specification sheets are submitted to QA section for review of important material. Design Sections checks material against vendor's drawing. Infrequent problem.
B2.14 What is the level of detail in a composite drawing? How does it identify system components? How does the composite compare to the diagram?	Piping runs are specified and details for fabrication are provided in spool piece hand sketch format. Diagram comparison to composite not addressed.

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RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
B2.15 How well integrated are standard vendors (CAD, purchase specifications, vendor furnished information)?	SHI has a "standard Japanese manufacturers" listing, however, they are using foreign manufacturers more frequently, as economics dictate. Incorporation of vendors standards in CAD will follow on with the adaptation and implementation of CAD systems for outfit design.
B.3 INTERNAL APPROVAL PROCESSES FOR STANDARDS APPLICATIONS	
B3.1 Is there a formal process for maintenance of standards?	No Response
B4. PREDOMINANT STANDARDS USED BY REGULATORY AND CLASSIFICATION BODIES:	
B4.1 How do our definitions of standard types compare with yours?	Basic understanding is different. Class rules and International Regulations applied to commercial ships are only a minimum requirement. Development of the standards and practices for these requirements is left to the individual shipyards' "know-how".
B4.2 Do you have other types of standards that you regularly use?	No Response
B4.3 Do you have standard vendors? If so, who are they?	Basically, no. Major equipment tends to be selected among 2-3 vendors - usually by purchasing.
B5. REGULATORY AUTHORITY AND CLASSIFICATION SOCIETY APPROVAL PROCESSES:	
B5.1 Which regulatory/classification bodies require approval of the standards?	Up to each standard. In general, they approve the drawings of each product, not the standard itself, except for national standards such as JIS. Typical standards are attached to the associated drawings for approval. Refer to Attachment (3) for a typical drawing list and owner and classification society approval requirements.
B5.2 How is regulatory/ classification body approval of standards handled?	See above.
B5.3 Which standards must be approved by these bodies?	Up to each standard.
B5.4 How do you view ISO 9000 certification?	SHI got ISO 9000 certified for Hull Structure in 1993 and intends to get Outfit Design certified in the future. 50% customer driven (especially for new customers unfamiliar with SHI's practices and procedures). Seems to be a requirement for all environmental projects. ABS anticipates most major Japanese shipyards will have certification within three years.
B6. USE OF SHIPYARD STANDARDS VERSUS ORGANIZATION STANDARDS:	
B6.1 What are most of the shipyard standards based on? ...JIS, ISO, ???	Material - JIS. (Hull construction materials per classification society requirement.)
B6.2 How do the shipyard standards compare to other national or international standards?	SKU is mainly based on JIS (JIS is trying to adopt ISO as far as possible).

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RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
B7. FORMAT OF SHIPYARD STANDARDS:	
B7.1 What are the perceived benefits of standards?	No Response
B7.2 How are preferred standards identified?	SHI standards are applied as preferred.
B7.3 How do you identify the following requirements in your standards?	
Engineering selection criteria?	Selected by Design with input from Production and Procurement Departments.
Identification on engineering products	Mainly identified on the drawings where used.
Fabrication information for suppliers?	Applicable standard is provided to the manufacturer involved.
Fabrication test requirements?	Mainly identified on the drawings where used.
Installation information for production personnel?	Mainly identified on the drawings where used.
Installation test requirements?	No Response
B7.4 What are come recent changes in your standards program?	No Response
B8. EXAMPLES OF TYPICAL SHIPYARD STANDARDS:	
B8.1 What are your standards for the following applications?	
Pipe hangers	SHI's SKU standard - See Attachment (3)
Ladders	SHI's SKU standard - See Attachment (3)
Wireways	SHI's SKU standard - See Attachment (3)
B8.2 Are these parts built by the yard or by sub-contractors?	Parts are manufactured by a subcontractor, in the majority of cases, in accordance with SHI's SKU Outfitting Standard.
B8.3 Are subcontractor's parts specified or does subcontractor build to shipyard requirements?	above
B8.4 What primary factors influence these designs?	
Internal shipyard processes?	Each case possible.
National/International Organizations?	Each case possible.

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RESPONSE TO QUESTIONS FROM SHI OPPAMA SHIPYARD, YOKOSUKA, JAPAN

NSRP SP 6 PROJECT 6-94-1 QUESTIONS	SHI OPPAMA SHIPYARD RESPONSE
Classification Societies?	Each case possible.

ATTACHMENT (1)

- **Shipyard Construction Commitments Current as of March, 1994**
- **Ships Constructed Over 4 Year Period Ending November, 1993**

As of 18th March 1994

Current Shipyard Construction Commitment

Hull No.	Owner	Type	GT	DWT	Class	Speed(VT)	Commencement	Delivery
1183	Bergesen d.y. A/S	Tanker (D/H)	156,000	278,800	DnV	16.9	2Q. '93	1Q. '94
1191	Marubeni Corporation	Tanker (D/H)	53,000	95,000	NK	14.7	3Q. '92	1Q. '94
1193	Japanese Owner	Bulk Carrier	36,000	70,000	NK	14.0	4Q. '93	2Q. '94
1194	Daiichi Chuo Kisen	Bulk Carrier	36,000	70,000	NK	14.0	1Q. '94	3Q. '94
1195	Japanese Defence Agency	ASE			-		1Q. '94	1Q. '95
1196	Japanese Owner	Bulk Carrier	36,000	70,000	NK	14.0	1Q. '94	3Q. '94
1197	Kanmon Harbor Construction	Dredger			JG	-	4Q. '93	1Q. '94
1198	Wilh Wilhelmsen	Car/Truck Carrier	49,500	17,600	DnV	19.1	2Q. '94	4Q. '94
1199	Daiichi Chuo Kisen	Coal Carrier	48,500	86,360	NK	14.5	3Q. '94	1Q. '95
1200	Japanese MOT	Patrol Boat	1,000				1Q. '95	4Q. '95
1201	Kojima-gumi	Grab type Dredger			JG	-	3Q. '94	2Q. '95
1202	Greek Owner	Tanker (D/H)	160,200	279,000	ABS	15.9	2Q, '95	1Q. '96
1203	Japanese Owner	Bulk Carrier	360,000	70,000	NK	14.0	3Q. '94	1Q. '95
1204	Hong Kong Owner	Bulk Carrier	36,000	70,000	ABS	14.0	4Q. '94	2Q. '95
1205	European Owner	Tanker (D/H)	53,000	95,000	DnV	14.4	1Q. '95	3Q. '95

Note: D/H means double hull construction

As of 5th December 1992

Current Shipyard Construction Commitment

Hull No.	Owner	Type	GT	DWT	Class	Speed(VT)	Commencement	Delivery
1170	Japanese Defence Agency	Destroyer	-	-	-	-	May '91	1Q. '93
1179	Wilh Wilhelmsen	Tanker	156,000	279,740	Dnv	15.9	Mar. '91	1Q. '93
1180	Japanese Defence Agency	Destroyer	-	-	-	-	Apr. '01	1Q. '93
1181	Japanese Defence Agency	Destroyer	-	-	-	-	Apr. '01	1Q. '93
1183	Bergesen d.y. A/S	Tanker (D/H)	156,000	278,800	DnV	16.9	2Q. '93	1Q. '94
1184	Onassis Group	Tanker (D/H)	156,000	280,000	ABS	15.9	2Q. '92	2Q. '93
1185	Mobil Shipping	Tanker (D/H)	157,000	280,000	ABS	16.2	4Q. '92	3Q. '93
1186	Italian Owner	Bulk Carrier	36,600	70,100	NK	15.7	3Q. '92	2Q. '93
1187	Daiichi Chuo Kisen	Bulk Carrier	76,500	150,350	NK	16.3	1Q. '93	4Q. '93
1188	Oasaka City	Tall Ship	320	-	JG	8.5	3Q. '92	2Q. '93
1190	Japanese Defence Agency	Destroyer	-	-	-	-	2Q. '91	2Q. '93

Note: D/H means double hull construction

For reference

LIST OF SHIPS CONSTRUCTED FOR LAST FOUR YEARS

Hull No.	Yard	Type	Class	Name	Owner	D. W. (G. T.)	L×B×D×d (M)	Contractual Delivery	Actual Delivery
1161	OPPAMA	95 TANKER	NK	CHANNEL DRAGON	THAMES SHIPPING CORPORATION (GOG)	98,757 (51,972)	222.064×42.0×20.3 14.0	'90-03-31	'90-01-23
1162	OPPAMA	95 TANKER	NK	OLYMPIC SPIRIT	MONTEGO TRANSPORTATION COMPANY (ONASSIS)	96,668 (52,086)	222.064×42.0×20.3 14.0	'90-03-01	'90-03-01
1163	OPPAMA	95 TANKER	NK	OLYMPIC SYMPHONY	CLEVEDON TRANSPORTATION COMPANY (ONASSIS)	96,672 (52,088)	222.064×42.0×20.3 14.0	'90-05-31	'90-05-31
1165	OPPAMA	95 TANKER	ABS	MARIA LAURA	AMADEUS MARITIME COPORATION (SCINICARIELLO)	96,922 (52,049)	222.064×42.0×20.3 14.0	'90-09-05	'90-09-03
1167	OPPAMA	95 TANKER (D/H)	NK	OLYMPIC SERENITY	DOVER MARINE PANAMA S.A. (ONASSIS)	95,205LT (52,127)	222.128×42.0×20.3 14.2	'91-03-31	'91-03-27
1168	OPPAMA	95 TANKER	NK	PARROT LAKE	SHERIDAN SHIPPING CORP. (GOG)	96,934 (51,955)	222.064×42.0×20.3 14.0	'91-03-31	'91-01-31
1169	OPPAMA	140 BC	NV	BARTOLOMEU DIAS	BARTOLOMEU DIAS LTD. (KLAVENESS)	139,800 (75,054)	259.0×43.0×23.8 16.4/17.467	'90-11-30	'90-12-04
1171	OPPAMA	95 TANKER (D/H)	NV	JAHRE PROGRESS	FJORD PROGRESS COMPANY LTD. (JORGEN JAHRE)	96,765 (52,164)	222.128×42.0×20.3 14.2	'91-06-30	'90-06-27
1173	OPPAMA	95 TANKER (D/H)	NV	JAHRE PRINCESS	FJORD PRINCESS COMPANY LTD. (JORGEN JAHRE)	96,648 (52,164)	222.128×42.0×20.3 14.2	'91-09-30	'91-09-27
1174	OPPAMA	95 TANKER (D/H)	NK	STENA CONCERTINA	PERENNIAL TRANSPORT (MOL)	96,500MT (53,000)	222.064×42.0×20.3 14.0	'92-02-29	'91-02-29

Oppama Shipyard Only.

LIST OF SHIPS CONSTRUCTED FOR LAST FOUR YEARS

Hull No.	Yard	Type	Class	Name	Owner	D. W. (G. T.)	L×B×D×d (M)	Contractual Delivery	Actual Delivery
1175	OPPAMA	140 BC	NK	FIRST SUN	MARS SHIPPING (DAIICHI CHUO KISEN)	140,000/ 150,400MT (76,500)	259.000×43.0×23.8 16.4/17.38	'91-12-15	'91-12-12
1179	OPPAMA	VLCC (S/H)	NV	TARTAR	SUMITOMO SHOJI/ WILH WILHELMSEN	279,000/ 300,700 (156,000)	317.0×60.6×30.6 20.4/21.7	'92-12-20	'93-01-12
1182	OPPAMA	95 TANKER (S/H)	ABS	PAOLA II	UNION TANKER CORP. (SCINICARIELLO)	95,000LT (53,000)	220.064×42.0×20.3 14.0	'92-06-30	'92-05-28
1184	OPPAMA	VLCC (D/H)	ABS	OLYMPIC LOYALTY	ONASSIS	278,800/ 301,600 (159,500)	317.0×58.0×31.4 20.6/22.0	'93-05-31	'93-03-24
1185	OPPAMA	VLCC (D/H)	ABS	EAGLE	MOBIL	280,000/ 301,500	317.0×58.0×31.4 20.6/22.0	'93-11-30	'93-08-25

ATTACHMENT (2)

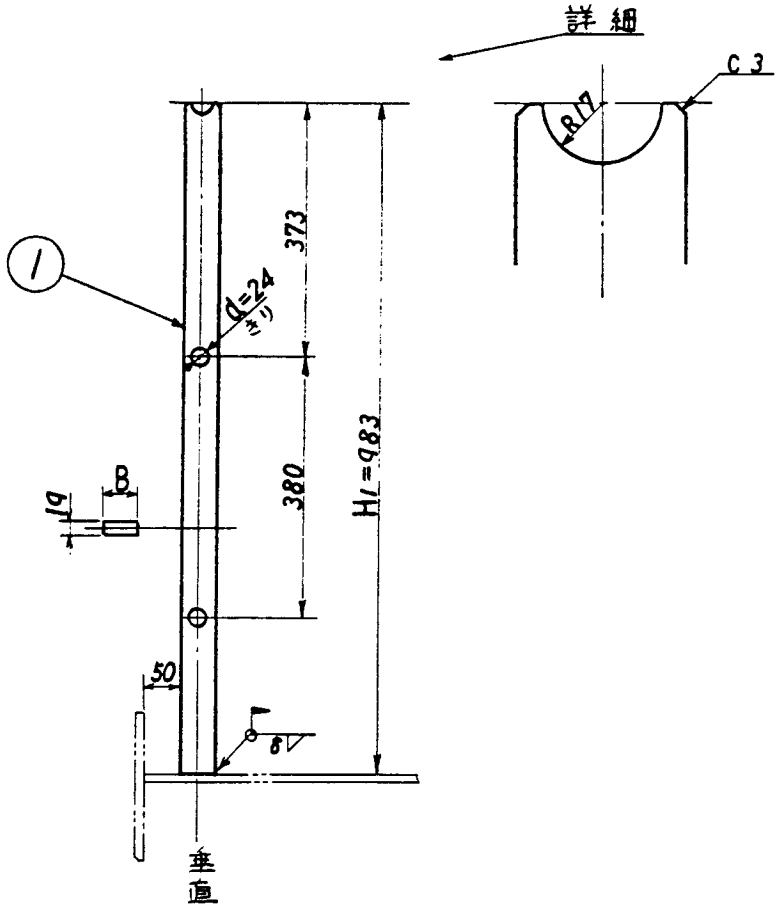
- **Example of SHI's Categories Of Standards for Basic Structures Design Group and Hull Construction Design Group**

- **Example of SHI Standards for Vertical Ladders, Wireways and Pipe Hangers**

前回ノモノト引換ノコト

SKU	手すり柱 HM 1, 2 HANDRAIL STANCHION	SKU No. 8547 000 0022 ～ 0023 B UNIT SCALE mm 1/10, 1/2 9/20

詳細



MARK	B	MASS kg	SKU NO.		
HM 1	50	7.1	8547	000	0022
HM 2	65	9.3	〃	〃	0023

配図		
在材G		適船体
		適機関
船長辺		適電気
機長辺		
定長辺		
上辺		検査
第2辺		修理計
外		その他
内		
中長		扣
船長		合計

備考

1. 取付ける適用甲板
   HM 1 …… 上層甲板
   HM 2 …… 乾舷甲板及び船楼甲板
2. d寸法は、中間棒に 15A SGP を使用する場合を示す。中間棒に φ19RB を使用する場合は d=21 とし、その都度指示すること。

MARK	NAME	MATERIAL	SKU NO	NO	ONE MASS KG	SUM MASS KG	REMARK
1	STANCHION	SS-F		1			

BILL OF MATERIALS PER ONE SET

制定	日付	記事	改正	日付	記事
	1973-10-1		1	1985-3-20	高さ、寸法表改正
			2	1989-3-27	質量改正
			3		
			4		
			5		

部比
運比
体比

前回ノモノト引換ノコト

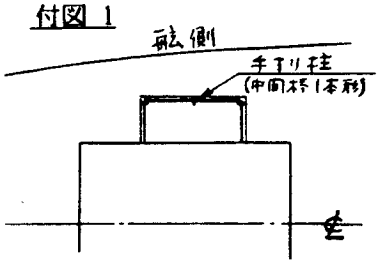
SKU	手すり柱 使用区分 CLASSIFICATION OF HANDRAIL STANCHION	S K U No. 8547 000 ～ 0001 0056 C UNIT SCALE mm 第三角法 2/20

1. 適用範囲

1.1 手すり柱の中間棒の間隔は、INTER NATIONAL CONVENTION ON LOAD LINES. 1966 により定めた。

1.2 この規格は、乾舷甲板、船楼甲板及び上層甲板に取付ける手すり柱に適用する。
但し付図 1のように上層甲板が舷側に達していない場合は、中間棒 1本形を使用する。

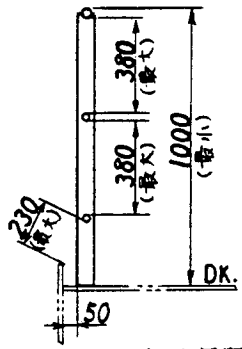
付図 1



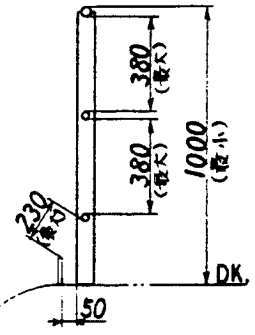
2. 寸法

寸法は付図 2～ 4の通りとする。

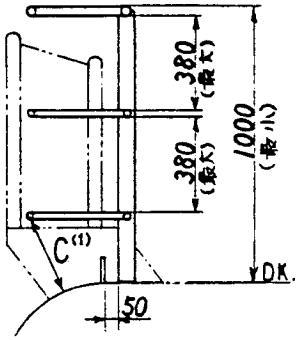
付図 2



付図 3



付図 4

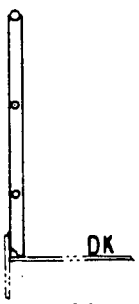


注 (1)付図 4の如く係留金物に手すりを取付ける場合は、C 寸法を 230㎜ 以下とすること。従って中間棒の間隔が 380㎜以上になる場合は、係留金物が取付けられる範囲のみ中間棒を増設すること。

3. その他の注意事項

3.1 手すり柱の間隔は 1600㎜ 以内とする。
3.2 手すり柱用 ｽﾃｰは、手すり柱 3本に 1本の割合で取付けること。
3.3 TOP RAIL及び ﾎﾞﾙﾄﾅｯﾄ は亜鉛 ﾒｯｷを施行すること。
3.4 手すり柱の取付けは垂直とし、その位置は ｶｰﾃﾝﾌﾟﾚｰﾄ の内側から 50㎜ 離して取付けること。但し船楼甲板以上で通路幅が 700㎜以下の場合は付図 5の如く ｶｰﾃﾝﾌﾟﾚｰﾄ に直接取付けること。

付図 5



改正	実施番船

MARK	N A M E	MATERIAL	S K U NO	NO	ONE MASS. kg	SUM MASS. kg	REMARK

BILL OF MATERIALS PER ONE SET

制定	日付	1973-10-1	改正	1 1974-6-18	2 1985-3-20	3 1989-3-27	4	5
	記事			4章文章改正		1.2 但書き、3章追加改正 付図1.5追記		

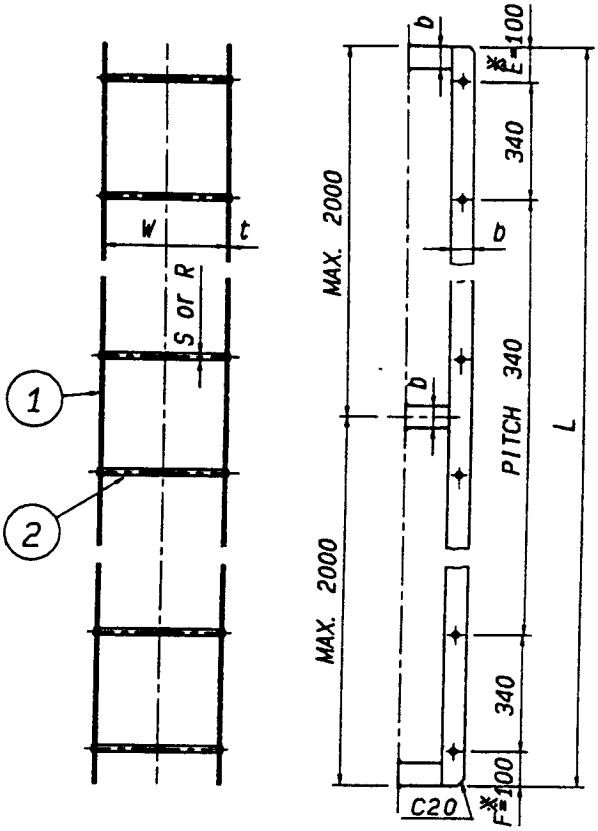
SKU

鋼製垂直はしご (L D)
STEEL VERTICAL LADDER

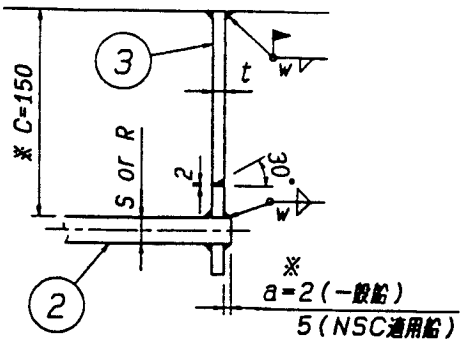
SKU NO. 8541 0000225 ~ 9230 F

UNIT mm

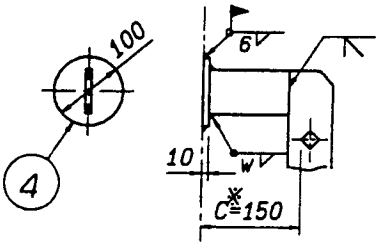
SCALE 1/5. 1/10. 1/20



DETAIL OF STEP



DETAIL OF PAD



MARK	W	b	t	w	SorR	PAD有無	MASS kg/m	SKU NO.		
LD25S	250	50	9	6	19X19	なし	10.4	8541	000	0225
						あり	11.6	〃	〃	1225
LD25R	250	50	9	6	φ19	なし	9.8	〃	〃	2225
						あり	11.1	〃	〃	3225
LD30S	300	50	9	6	19X19	なし	10.8	〃	〃	0230
						あり	12.0	〃	〃	1230
LD30R	300	50	9	6	φ19	なし	10.2	〃	〃	2230
						あり	11.4	〃	〃	3230
LD30S$_1$	300	65	9	6	19X19	なし	13.1	〃	〃	4230
						あり	14.4	〃	〃	5230
LD30R$_1$	300	65	9	6	φ19	なし	12.5	〃	〃	6230
						あり	13.7	〃	〃	7230
LD30A	300	50	4.5	4	19X19	なし	6.7	〃	〃	8230
						あり	7.9	〃	〃	9230
LD35S	350	50	9	6	19X19	なし	11.2	〃	〃	0235
						あり	12.4	〃	〃	1235
LD35R	350	50	9	6	φ19	なし	10.5	〃	〃	2235
						あり	11.7	〃	〃	3235
LD35S$_1$	350	65	9	6	19X19	なし	13.6	〃	〃	4235
						あり	14.8	〃	〃	5235
LD35R$_1$	350	65	9	6	φ19	なし	12.8	〃	〃	6235
						あり	14.1	〃	〃	7235
LD40S	400	65	9	6	22X22	なし	15.2	〃	〃	0240
						あり	16.5	〃	〃	1240
LD40R	400	65	9	6	φ22	なし	14.1	〃	〃	2240
						あり	15.4	〃	〃	3240

改正	実施番船

備考
1. ※印寸法は標準を示す。
2. L寸法は、使用の都度指示すること。
3. LD-30Aは L寸法2m以内とし主に機関室内床板に取りつける。
4. 計算質量はL=3m(中間ブラケット1組を含む)の平均質量とした。

MARK	NAME	MATERIAL	SKU NO.	NO.	ONE MASS kg	SUM	REMARK
4	PAD	SS-P			0.62		
3	BRACKET	SS-F			0.44~.50 0.54~.65		
2	STEP	SS-B					
1	STRINGER PL.	SS-F		2			

BILL OF MATERIALS PER ONE SET

制定	日付	1974-6-3	改正	6	1993-12-24	7		8		9		5	1985-1-25
	記事				質量改正								番船追加 SKU NO.及び質量改正

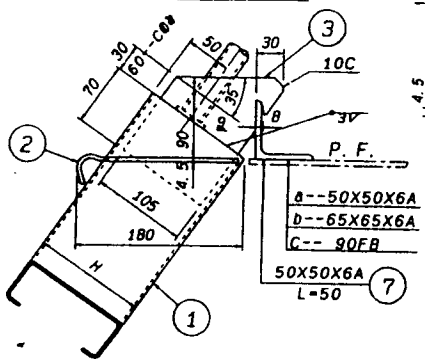
SKU

鋼製はしご LDC
STEEL LADDER

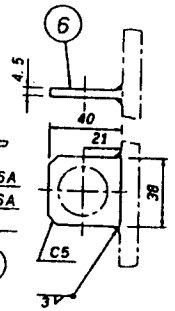
SKU NO. 8542 0200400 ～ 0214600 B

UNIT SCALE 1/2 1/5 1/2

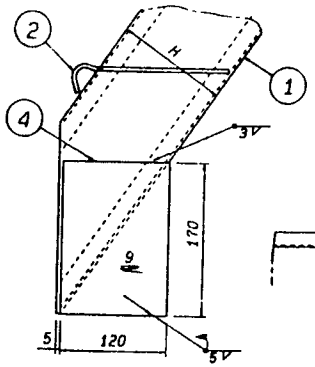
Ⓑ DETAIL

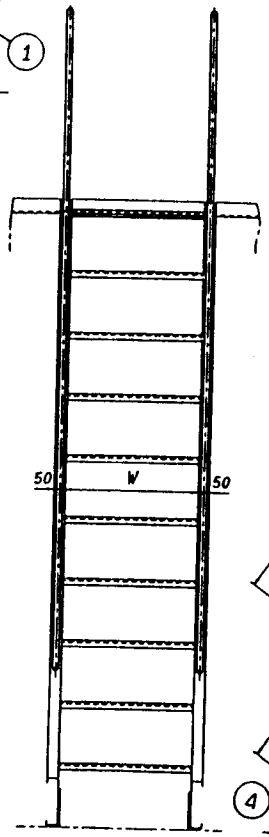


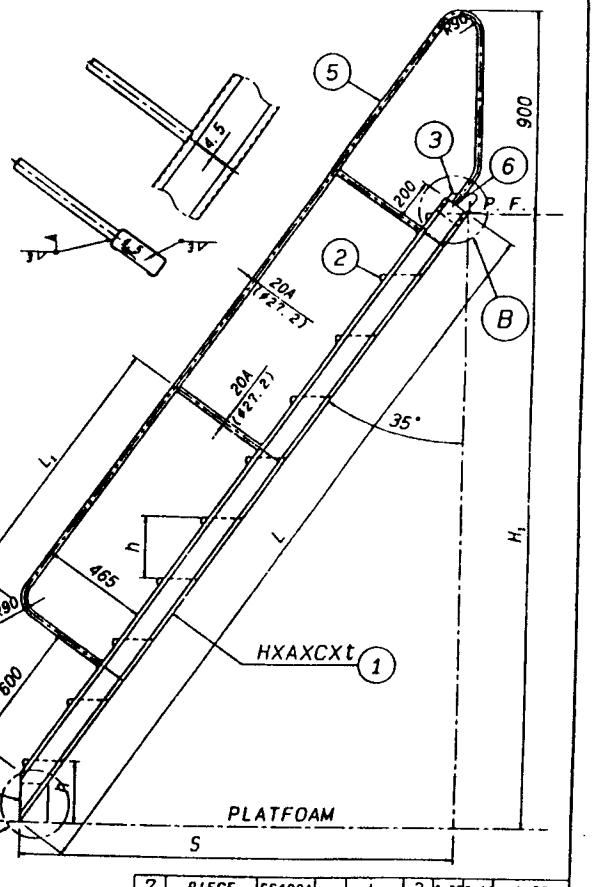
⑥ DETAIL



Ⓐ DETAIL







MARK	HXAXCXt	H1	S	W	L	L1	中間手摺数量	NO. OF STEP	MASS Kg	SKU NO.
LDC-4	125X50X20X3.2	500	350	400	610	-	-	2	15.8	8542 0200400
〃 -5	〃	〃	〃	500	〃	-	-	〃	17.3	〃 〃 0500
〃 -6	〃	〃	〃	600	〃	-	-	〃	18.9	〃 〃 0600
〃 -4	〃	750	525	400	916	-	-	3	22.6	〃 〃 1400
〃 -5	〃	〃	〃	500	〃	-	-	〃	25.0	〃 〃 1500
〃 -6	〃	〃	〃	600	〃	-	-	〃	27.3	〃 〃 1600
〃 -4	〃	1000	700	400	1221	-	-	4	29.5	〃 〃 2400
〃 -5	〃	〃	〃	500	〃	-	-	〃	32.6	〃 〃 2500
〃 -6	〃	〃	〃	600	〃	-	-	〃	35.8	〃 〃 2600
〃 -4	〃	1250	875	400	1526	-	-	5	46.7	〃 〃 3400
〃 -5	〃	〃	〃	500	〃	-	-	〃	50.6	〃 〃 3500
〃 -6	〃	〃	〃	600	〃	-	-	〃	54.5	〃 〃 3600
〃 -4	〃	1500	1050	400	1831	-	2	6	54.5	〃 〃 4400
〃 -5	〃	〃	〃	500	〃	-	2	〃	59.2	〃 〃 4500
〃 -6	〃	〃	〃	600	〃	-	2	〃	63.9	〃 〃 4600
〃 -4	〃	1750	1225	400	2136	-	2	7	63.9	〃 〃 5400
〃 -5	〃	〃	〃	500	〃	-	2	〃	69.3	〃 〃 5500
〃 -6	〃	〃	〃	600	〃	-	2	〃	74.8	〃 〃 5600
〃 -4	〃	2000	1400	400	2441	1200	2	8	73.3	〃 〃 6400
〃 -5	〃	〃	〃	500	〃	〃	2	〃	77.2	〃 〃 6500
〃 -6	〃	〃	〃	600	〃	〃	2	〃	83.5	〃 〃 6600
〃 -4	〃	2250	1575	400	2746	〃	4	9	78.9	〃 〃 7400
〃 -5	〃	〃	〃	500	〃	〃	4	〃	84.0	〃 〃 7500
〃 -6	〃	〃	〃	600	〃	〃	4	〃	86.9	〃 〃 7600
〃 -4	〃	2500	1750	400	3052	1050	4	10	84.0	〃 〃 8400
〃 -5	〃	〃	〃	500	〃	〃	4	〃	87.9	〃 〃 8500
〃 -6	〃	〃	〃	600	〃	〃	4	〃	95.7	〃 〃 8600
〃 -4	〃	2750	1925	400	3357	1200	4	11	103.6	〃 〃 9400
〃 -5	〃	〃	〃	500	〃	〃	4	〃	95.7	〃 〃 9500
〃 -6	〃	〃	〃	600	〃	〃	4	〃	104.3	〃 〃 9600
〃 -4	150X50X20X3.2	3000	2115	400	3671	〃	4	12	113.0	〃 〃 0021 0400
〃 -5	〃	〃	〃	500	〃	〃	4	〃	107.6	〃 〃 0500
〃 -6	〃	〃	〃	600	〃	〃	4	〃	117.0	〃 〃 0600
〃 -4	〃	3250	2290	400	3976	1000	6	13	126.4	〃 〃 1400
〃 -5	〃	〃	〃	500	〃	〃	6	〃	127.0	〃 〃 1500
〃 -6	〃	〃	〃	600	〃	〃	6	〃	137.2	〃 〃 1600
〃 -4	〃	3500	2465	400	4281	1100	6	14	125.2	〃 〃 2400
〃 -5	〃	〃	〃	500	〃	〃	6	〃	136.1	〃 〃 2500
〃 -6	〃	〃	〃	600	〃	〃	6	〃	147.2	〃 〃 2600
〃 -4	〃	3750	2640	400	4586	1200	6	15	133.4	〃 〃 3400
〃 -5	〃	〃	〃	500	〃	〃	6	〃	145.1	〃 〃 3500
〃 -6	〃	〃	〃	600	〃	〃	6	〃	157.0	〃 〃 3600
〃 -4	〃	3999	2815	400	4890	〃	6	16	141.6	〃 〃 4400
〃 -5	〃	〃	〃	500	〃	〃	6	〃	154.1	〃 〃 4500
〃 -6	〃	〃	〃	600	〃	〃	6	〃	166.8	〃 〃 4600

備考
1. このはしごは，非危険部に使用すること．
2. 手すりは，H_1=1250以上に取付けること．
3. h寸法は，H_1の高さに応じて250±30の範囲になるように取付けること．
4. 手すりの取付けは，はしご取付け場所で溶接すること．
5. 上部取付部にコーミングがある場合は，符号 ③ の a, b, c を，使用の都度指示すること．
（この場合は符号 ⑦ を不要とする．）

NO.	NAME	MATERIAL	SKU NO.	NO.	ONE SET MASS kg	SUM MASS kg	REMARK
7	PIECE	SS400A		2	9.220	44	L-50
6	END PLATE	SS-F		2	0.850	10	
5	HAND RAIL	SGP		2			
4	LOW PIECE			2	1.462	88	
3	TOP PIECE			2	1.842	06	
2	STEP	SS400P	8542 0510400 ～ 0600	2-16			
1	STRINGER PL	SSC400		2			

BILL OF MATERIALS PER ONE SET

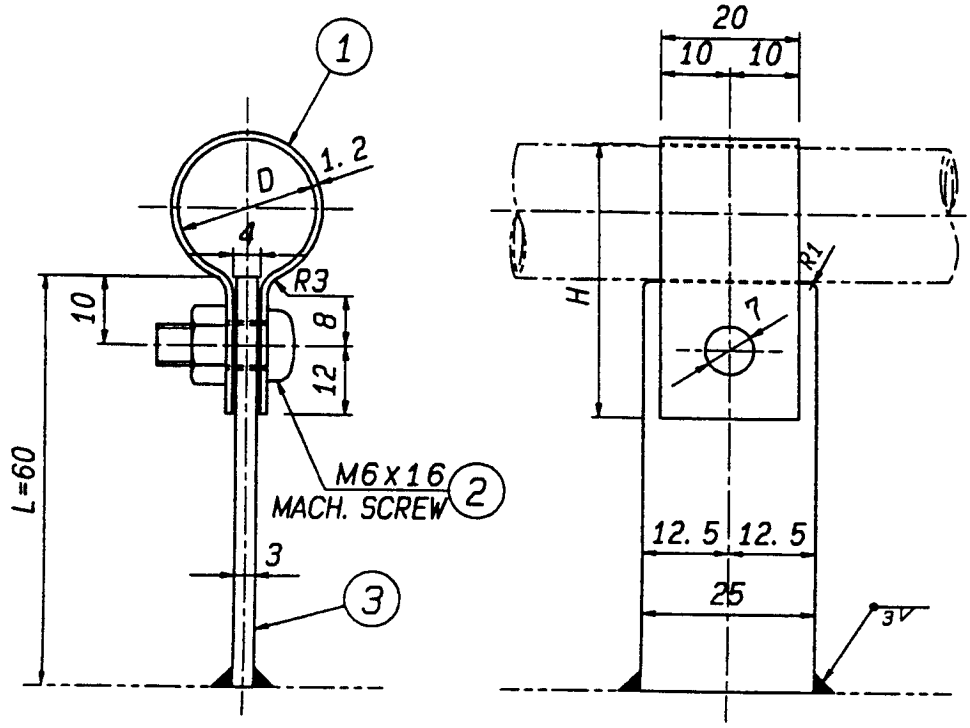
制定	日付	1984-7-2	改正	1 1986-4-25 中間手摺の位置一部変更	2 1994-3-25 材質名称変更	3	4	5

1-7

SKU

管用バンド（鋼壁付）
BAND FOR PIPE

S K U NO.	8478	003 0010 ~ 1020	D
UNIT	mm		
SCALE	1/1		



PIPE	NOMI. DIA.	D	H	MASS kg	SKU NO.
COPPER PIPE	10	15	37.5	0.06	8478 003 0010
	15	20	43	0.07	〃 〃 0015
	20	25	48	0.07	〃 〃 0020
STEEL PIPE	15	21.7	44.5	0.07	〃 〃 1015
	20	27.2	50	0.07	〃 〃 1020

改正	実施番号

備考
1. このバンドは、主として給水管に使用する。
2. L寸法は、標準を示す。

MARK	NAME	MATERIAL	SKU NO.	NO.	MASS ONE	MASS SUM	REMARK
3	BAND REST	SS-F		1		0.034	ZINC HOT DIP GALV.
2	PAN HEAD MACH. SCREW	C2600W	3660 017 6016	1		0.009	M6x16
1	BAND	C2600P		1		0.019 ○ 0.026	

BILL OF MATERIALS PER ONE SET

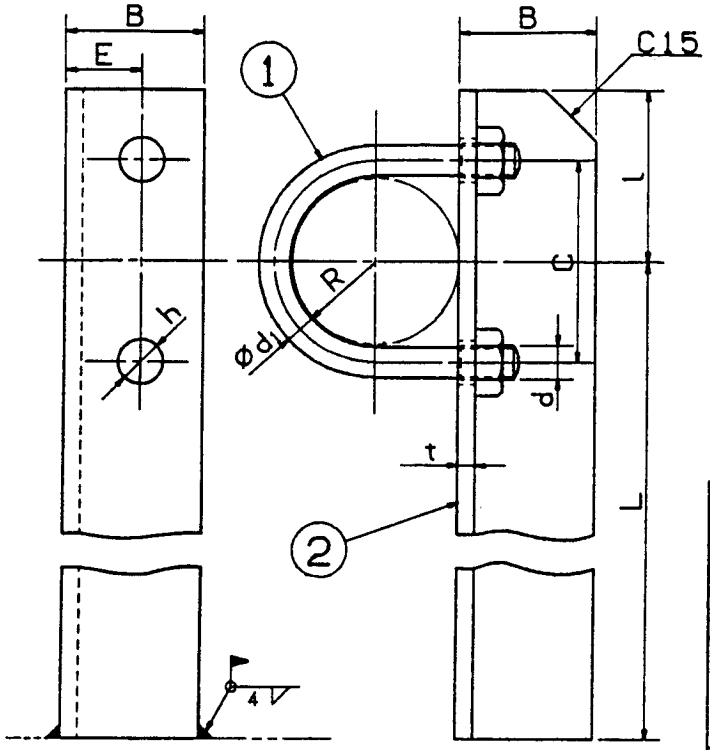
制定	日付	1973-10-1	改正	1	1977-8-25	2	1984-11-30	3	1986-1-31	4	1994-12-25	5	
	記事			呼U10, 15E分削		鋼管用呼U20, 鋼管用追加 名称改正, 備考2追加		L寸法、質量改正		質量改正			

SKU

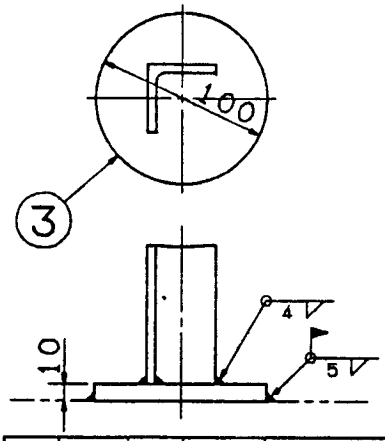
鋼管用台付Uボルト（E形15~80）

U-BOLT WITH REST FOR STEEL PIPE

SKU NO.	8475 ~	0007015 0017081
UNIT mm SCALE		11/17



パッド付の場合



NOM. SIZE	OUT DIA OF PIPE	B	t	R	d	d1	h	C	l	E
15	21.7	40	5	11	M10	9	13	32	30	22
20	27.2	40	5	14	M10	9	13	38	35	22
25	34.0	40	5	18	M10	9	13	46	40	22
32	42.7	40	5	22	M10	9	13	54	45	22
40	48.6	40	5	25	M10	9	13	60	50	22
50	60.5	40	5	31	M10	9	13	72	55	22
65	76.3	50	6	39	M12	10	15	91	75	30
80	89.1	50	6	45	M12	10	15	103	80	30

NOM. SIZE	L	パッド有無	MASS (kg)	SKU NO.	
15	300	無	1.05	8475	0007015
		有	1.64	〃	0007016
	500	無	1.64	〃	0017015
		有	2.23	〃	0017016
20	300	無	1.07	〃	0007020
		有	1.66	〃	0007021
	500	無	1.66	〃	0017020
		有	2.25	〃	0017021
25	300	無	1.10	〃	0007025
		有	1.69	〃	0007026
	500	無	1.69	〃	0017025
		有	2.28	〃	0017026
32	300	無	1.12	〃	0007032
		有	1.71	〃	0007033
	500	無	1.71	〃	0017032
		有	2.30	〃	0017033
40	300	無	1.15	〃	0007040
		有	1.74	〃	0007041
	500	無	1.74	〃	0017040
		有	2.33	〃	0017041
50	300	無	1.18	〃	0007050
		有	1.77	〃	0007051
	500	無	1.77	〃	0017050
		有	2.36	〃	0017051
65	300	無	1.96	〃	0007065
		有	2.53	〃	0007066
	500	無	2.85	〃	0017065
		有	3.42	〃	0017066
80	300	無	2.01	〃	0007080
		有	2.58	〃	0007081
	500	無	2.90	〃	0017080
		有	3.47	〃	0017081

改正	承認番号

備考

1．パッド付の使用個所は、タンク内及び船内とする。

MARK	NAME	MATERIAL	SKU NO.	NO.	ONE MASS(kg)	SUM MASS(kg)	REMARK
3	PAD	SS-P		1		0.62	
2	REST	SS-A		1			
1	U-BOLT	SS400PRI NCH-R12	8473 000 0015 ~ 0080	1			J形

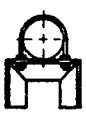
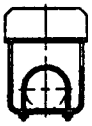
BILL OF MATERIALS PER ONE SET

制定	日付	1973-10-1	改正	1 1974-10-23	2 1975-12-10	3 1976-7-15	4 1985-5-31	5 1991-7-25
	記事			L寸法改正 SKU NO. 追加	図示改正 パッド付追加	50以下のD寸法改正	15~50のB, E, t 寸法、質量改正	材質記号、質量改正

添付

SKU	鋼管用Uボルト使用区分 APPLICATION OF U-BOLT	SKU NO.	8473 0000015 D 8475 0016050
		UNIT SCALE	mm 1/17

1．適用範囲

区分＼形式	A形 (15~80)	A形 (100~150)	B形 (15~80)	C形 (100~200)	D形 (100~1000)	E形 (15~80)	E形 (100~150)	F形 (15~80)	G形 (100~1000)	U形 (20, 40, 50)
										
暴露甲板（上甲板、船首尾楼甲板）								○	○	
貨物艙内								○	○	
荷油艙内					○			○	○	
船首尾水艙内								○	○	
深水艙内 トップサイドタンク内					○			○	○	
二重底内（含ダクトキール内）			○（加熱管のみ）	○	○			○	○	○
主、補助ポンプ室内 油圧ポンプ室内	○	○							○	
居住区画内	○	○				○	○		○	
応急消火ポンプ室内	○	○							○	
CO_2 消火管	○	○				○	○	○	○	
機関室内	○	○	○（加熱管のみ）	○	○（管径250A以上）					

改正	実施番号

2．亜鉛めっき

清水及び飲料水タンク内に取付くものは、亜鉛めっきを施すこと。

3．Uボルトの間隔

間隔は、SD51U02 管用バンドの間隔 による。

4．Uボルトの材質

NCH−R12は、NKKのみがき用棒鋼を示す。

5．ボルト穴は、ドリル又は打込みのこと。

制定	日付	1973-10-1	改正	1 1974-10-23	2 1975-7-10	3 1975-12-10	4 1991-7-25	5
	記事			F形改正、H形削除 備考6追加	S形追加	形式改正	備考改正	

Items of Standard of hull construction design group

Standard or manual name

1 Attribute input manual of hull-construction for CADAM

2 Nesting manual

3 Operation manual of steel order & control system

4 JCL(Job control language) list for NC works

5 Working manual of steel order specification

6 Sumitomo Hull Standard (SHS)

7 Notice list for detail design

Items of Standards of basic structure design group

Standard or manual name

1 Reinforcement of knuckle part of hull structure

2 Welding of parts to sheer strake

3 Welding of crane post and david

4 Installation of pad plate with fittings on upper deck

5 Design of water course

6 Standard of brackets

7 Quality of scallop

8 Method of loading of external pressure to FEM model

9 Rolling of double skin tanker

10 Weld design application

11 Dimensions of hatch coaming

12 Racking strength of PCC

13 Allowable stress of transverse parts due to ABS rule

14 Sloshing load on center tank of tanker

15 Distribution data of sectinal properties of hull structure

16 Shearing force calculation for side shell and longitudinal bulkhead

17 Side stringer position in engine room

18 Dimensions of structural part of car deck

19 Estimation of deformation of liftable deck

20 Structural design standard of superstructure

21 Standard of key plan drawing of superstructure for applying to yard plan

22 User's manual of computer program "TSLAN"

23 Calculation method of transverse part in midship section

24 Design manual of marina type stern frame and rudder

25 Calculation of truss type radar mast vibration

26 Arrangement of steel wall in superstructure

27 Effectiveness of steel wall against of superstructure vibration

ATTACHMENT (3)

- **Listing of Drawings and Approval Requirements for Diesel Propelled Bulk Carrier**

構造 計画 G

S. NO. 1218

SINGLE SCREW DIESEL PROPELLED BULK CARRIER

LIST OF DRAWINGS FOR APPROVAL

DATE: Oct. 10th, 1995

T. Takiguchi

T. TAKIGUACHI
GENERAL MANAGER
DESIGN DEPARTMENT
OPPAMA SHIPYARD
SUMITOMO HEAVY INDUSTRIES, LTD.

DWG. NO. 00310

黒塗りファイル.

DISTRIBUTION

OWNER	1
NK	2
BUILDER'S FILE	6
TOTAL	9

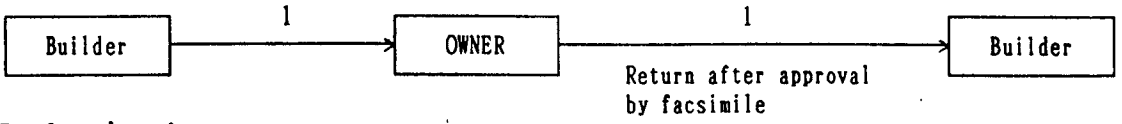
N O T E

1. The marks in this list,

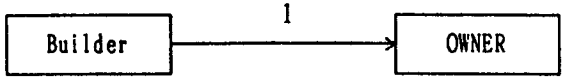
   A : Drawings to be submitted by Builder for approval
   R : Drawings to be submitted by Builder for reference
   * : Drawings to be submitted by Venders for approval to NK
   L : Drawings to be submitted by Builder to local surveyor or superintendent

2. The number of copies and sending process,

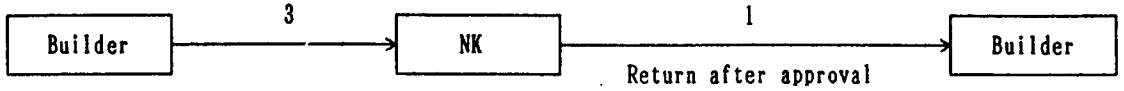
   (a) For Owner's approval



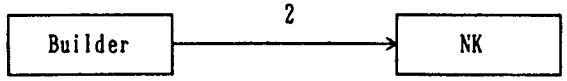
   For Owner's reference



   (b) For NK approval



   For NK reference



S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
00310	LIST OF DRAWING FOR APPROVAL	A	SUBMITT. APPROVED	R		
01320	LIST OF FINAL DRAWINGS - HULL	A	SUBMITT. APPROVED			
01400	GENERAL ARRANGEMENT	A	SUBMITT. APPROVED	A	11/30	
01500	EQUIPMENT NUMBER	R	SUBMITT. APPROVED	A		
03220	HYDROSTATIC TABLE	R	SUBMITT. APPROVED			
03310	CAPACITY PLAN	R	SUBMITT. APPROVED	R		
05110	TRIM & STABILITY CAL. INC. STABILITY CROSS CURVES	R	SUBMITT. APPROVED			
05410	GRAIN LOADING CAL.	R	SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT. / APPROVED			
06411	PARTICULAR - FREEBOARD	R	SUBMITT. / APPROVED			
06430	FLOODABLE CAL. - FREEBOARD	R	SUBMITT. / APPROVED			
07202	GUIDANCE FOR DRAFT ADJUSTMENT	L	SUBMITT. / APPROVED	L		
07210	SCHEME OF WEIGHTING TEST	A	SUBMITT. / APPROVED	A		
07310	SCHEME OF SEA TRIAL HULL. PART, MACH. PART, ELECT. PART	A	SUBMITT. / APPROVED	A		
07320	ESTIMATED SPEED POWER CURVE	R	SUBMITT. / APPROVED			
07330	TEST SCHEDULE OF HULL VIBRATION	L	SUBMITT. / APPROVED			
07340	SCHEDULE FOR MEASURMENT OF NOISE LEVEL	L	SUBMITT. / APPROVED			
07350	SCHEDULE FOR SEA TRIAL (MACHINERY PART)	A	SUBMITT. / APPROVED	R		
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
11110	LONGITUDINAL STRENGTH	R	SUBMITT. APPROVED			
11210	MIDSHIP SECTION	A	SUBMITT. APPROVED	A	11/30	
11220	GENERAL STRUCTURE	A	SUBMITT. APPROVED	A	11/30	
12110	RUDDER	A	SUBMITT. APPROVED			
12115	SCHEME OF PULL OUT RUDDER	R	SUBMITT. APPROVED			
12118	RUDDER CARRIER	A	SUBMITT. APPROVED			
12120	STERN FRAME	A	SUBMITT. APPROVED			
12210	SHELL EXPANSION	A	SUBMITT. APPROVED	A	11/30	
12215	ARRANGEMENT OF WORKING HOLES	R	SUBMITT. APPROVED			
12222	HOLD SECTION	A	SUBMITT. APPROVED			
			SUBMITT. APPROVED			

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE		NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT.				
			APPROVED				
12311	DOUBLE BOTTOM IN ENGINE ROOM	A	SUBMITT.		A	11/30	
			APPROVED				
12510	W.T. BULKHEAD - TRANS	A	SUBMITT.				
			APPROVED				
12610	ENGINE ROOM	A	SUBMITT.		A		
			APPROVED				
12710	BOW CONSTRUCTION	A	SUBMITT.				
			APPROVED				
12720	STERN CONSTRUCTION	A	SUBMITT.				
			APPROVED				
12800	GENERAL WORKING STANDARD FOR HULL STEEL CONSTRUCTION	R	SUBMITT.				
			APPROVED				
12820	DECK HOUSE	A	SUBMITT.				
			APPROVED				
12900	SCHEME OF HYDROSTATIC TEST	R	SUBMITT.				
			APPROVED				
			SUBMITT.				
			APPROVED				
			SUBMITT.				
			APPROVED				
			SUBMITT.				
			APPROVED				

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE		NK	SUBM. & APPR. DATE		REMARKS
			SUBMITT.					
			APPROVED					
21110	SURFACE TREATMENT OF STEEL	A	SUBMITT.					
			APPROVED					
21210	PAINTING SPEC - SCHEDULE	A	SUBMITT.					
			APPROVED					
21220	PAINTING SPEC - EXPOSED	A	SUBMITT.					
			APPROVED					
21311	CATHODIC PROTECTION - SHELL	A	SUBMITT.					
			APPROVED					
21315	ARRANGEMENT OF ANODES IN W.B. TANKS	A	SUBMITT.					
			APPROVED					
22010	MARKS FOR OUTSIDE SHELL (INCL. DRAFT MARK & HELICOPTER WINCHING MARK)	A	SUBMITT.					
			APPROVED					
22110	ARRANGEMENT OF SHIP'S NAME	A	SUBMITT.					
			APPROVED					
22320	FUNNEL MARK	A	SUBMITT.					
			APPROVED					
22610	NAME PLATE OF ROOM & KEYS	R	SUBMITT.					
			APPROVED					
22700	NOTICE BOARDS	A	SUBMITT.					
			APPROVED					
23200	PRACTICE & DETAIL OF PIPINGS	R	SUBMITT.					
			APPROVED					

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
24010	HULL PIPING DIAGRAM	A	SUBMITT. APPROVED	A		
24720	HYDRAULICALLY DRIVEN VALVE OPERATION SYSTEM	A	SUBMITT. APPROVED			
25010	ACCOM. PIPING DIAGRAM	A	SUBMITT. APPROVED	A		
27400	SEWAGE TREATMENT PLANT	A	SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT. / APPROVED			
31000	MOORING ARRANGEMENT	A	SUBMITT. / APPROVED			
31010	DECK MACHINERY	A	SUBMITT. / APPROVED	*		
31310	HAWSE PIPE	R	SUBMITT. / APPROVED			
31510	ANCHOR	R	SUBMITT. / APPROVED			
31520	ANCHOR CHAIN CABLE	R	SUBMITT. / APPROVED			
31530	WHARF LADDER	R	SUBMITT. / APPROVED			
32200	STEERING GEAR	A	SUBMITT. / APPROVED	*		
32300	MAGNETIC COMPASS	R	SUBMITT. / APPROVED			
32411	ARR'T OF NAV. LIGHT & SOUND SIGNAL	A	SUBMITT. / APPROVED	A		
33110	FORE MAST	A	SUBMITT. / APPROVED			
34010	RADAR POST	A				

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT. / APPROVED			
34010	GENERAL USE GEAR SYSTEM	A	SUBMITT. / APPROVED	A		
34100	SCHEDULE OF CARGO GEAR TEST FOR MISCELLANEOUS DAVIT (ON BOARD)	L	SUBMITT. / APPROVED	A		
34200	SUEZ BOAT, PROVISION & HOSE HANDLING CRANE	A	SUBMITT. / APPROVED	*		
34300	PROVISION & ENGINE PARTS HANDLING CRANE	A	SUBMITT. / APPROVED			
34500	PORTABLE SLUDE LIFTING DAVIT	R	SUBMITT. / APPROVED			
35000	TRAFFIC ARRANGEMENT	A	SUBMITT. / APPROVED			
35200	HOLD LADDER	A	SUBMITT. / APPROVED			
35300	ACCOM. LADDER SYSTEM & WINCH	A	SUBMITT. / APPROVED			
35624	PILOT ASSIST LADDER	A	SUBMITT. / APPROVED			
36010	LIFEBOAT LOWERING SYSTEM	A	SUBMITT. / APPROVED	A		
36100	LIFEBOAT	A	SUBMITT. / APPROVED	*		

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
36200	BOAT DAVIT & WINCH	R	SUBMITT. APPROVED	*		
36300	SCHEDULE OF TEST FOR LIFEBOAT/RESCUEBOAT DAVIT (ON BOAD)	L	SUBMITT. APPROVED	A		
36310	LIFE RAFT	A	SUBMITT. APPROVED			
37010	FIRE CONTROL PLAN & LIFE SAVING APPARATUS	A	SUBMITT. APPROVED	A		
37020	TEST SCHEME OF FIRE FIGHTING SYSTEM	L	SUBMITT. APPROVED	L		
37310	HIGH EXPANSION FOAM FIRE EXTINGUISHING SYSTEM	A	SUBMITT. APPROVED	*		
38500	FUNNEL	A	SUBMITT. APPROVED			
38600	DECK INVENTORY	L	SUBMITT. APPROVED			
38610	SPARE & TOOLS - HULL PART	L	SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
41000	CABINE ARRANGEMENT	A	SUBMITT. APPROVED	A		
42130	CEILING, LINING & DECK COVERING IN ACCOM.	A	SUBMITT. APPROVED			
42510	INSULATION & FIRE PROTECTION ARRANGEMENT	A	SUBMITT. APPROVED	A		
42810	COLOUR SCHEME IN ACCOM.	A	SUBMITT. APPROVED			
44000	VENTILATION SYSTEM IN ACCOM.	A	SUBMITT. APPROVED	A		
44010	TEST SCHEME OF VENT. SYSTEM IN ACCOMMODATION	L	SUBMITT. APPROVED			
44300	AIR CONDITIONING SYSTEM FOR ACCOM.	A	SUBMITT. APPROVED			
44520	PACKAGE COOLER FOR ENG. CONTROL ROOM	R	SUBMITT. APPROVED			
46120	WHEEL HOUSE	A	SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
48140	CATERING EQUIPMENT	A	SUBMITT. APPROVED			
48400	REFRIGERATING PLANT REF. PROV.	A	SUBMITT. APPROVED			
48411	SCHEME OF COOL. TEST REF. PROV.	L	SUBMITT. APPROVED			
49012	ARR'T OF STORES	A	SUBMITT. APPROVED	A		
49020	ARR'T STEERING ENG. ROOM	A	SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			

S. NO. 1218
HULL PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT. / APPROVED			
56200	WEATHER TIGHT HATCH COVER	R	SUBMITT. / APPROVED	*		
56610	ARR'T OF SMALL HATCH	A	SUBMITT. / APPROVED	A		
57000	CARGO HOLD VENTILATION SYSTEM	A	SUBMITT. / APPROVED	A		
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			

S. NO. 1218
MACH. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT. / APPROVED			
60320	LIST OF FINAL DRAWINGS - MACH.	A	SUBMITT. / APPROVED	R		
60213	L.O. CHART	R	SUBMITT. / APPROVED			
60420	ENGINE ROOM ARRANGEMENT	A	SUBMITT. / APPROVED	A		
61200	PARTICULAR OF MACHINERY PART	R	SUBMITT. / APPROVED	A		
61500	AUTOMATION TABLE & PLAN OF TEST ON BOARD MACH. & ELECT. PART	A	SUBMITT. / APPROVED			
62221	SPECIFICATIONS FOR MAIN ENGINE	R	SUBMITT. / APPROVED			
62225	M/E PIPING DIAGRAM	R	SUBMITT. / APPROVED	*		
62226	M/E SCHEME OF OFFICIAL SHOP TRIAL	R	SUBMITT. / APPROVED			
62231	M/E REMOTE CONTROL SYSTEM	R	SUBMITT. / APPROVED	*		
62400	M/E SPARE LIST	R	SUBMITT. / APPROVED			
62500	M/E TOOL LIST	R	SUBMITT. / APPROVED			

S. NO. 1218
MACH. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
62700	SHAFTING ARRANGEMENT (INCL. CALCULATION OF SHAFTING)	A	SUBMITT. / APPROVED	A		
62701	PROPELLER SHAFT WITHDRAWAL ARRANGEMENT	A	SUBMITT. / APPROVED			
62702	CAL. OF TORSIONAL VIBRATION	R	SUBMITT. / APPROVED	*		
62740	STERN BEARING ASSEMBLY	R	SUBMITT. / APPROVED			
62741	INTERMEDIATE SHAFT BEARING	R	SUBMITT. / APPROVED			
62750	STERN TUBE SEALING	R	SUBMITT. / APPROVED	*		
62800	PROPELLER	R	SUBMITT. / APPROVED			
62910	M/E FOUNDATION BOLT ARR'T (INCL. ARRANGEMENT OF M/E INSTALLATION)	A	SUBMITT. / APPROVED			
63200	MAIN DIESEL GENERATOR ENGINE	R	SUBMITT. / APPROVED	*		
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			

S. NO. 1218
MACH. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE						NK	SUBM. & APPR. DATE						REMARKS
			SUBMITT.													
			APPROVED													
63400	EMERGENCY DIESEL GENERATOR ENGINE	R	SUBMITT.						*							
			APPROVED													
63800	COMPOSITE BOILER	R	SUBMITT.						*							
			APPROVED													
64300	CENTRIFUGAL PUMP	R	SUBMITT.													
			APPROVED													
64410	SCREW PUMP	R	SUBMITT.													
			APPROVED													
64420	GEAR PUMP	R	SUBMITT.													
			APPROVED													
64430	SLUDGE PUMP	R	SUBMITT.													
			APPROVED													
64440	EMERGENCY FIRE PUMP	R	SUBMITT.													
			APPROVED													
64500	RECIPROCATION PUMP	R	SUBMITT.													
			APPROVED													
65200	MAIN AIR COMPRESSOR	R	SUBMITT.						*							
			APPROVED													
65510	MAIN AIR RESERVOIR	R	SUBMITT.						*							
			APPROVED													
66000	OIL PURIFIER	R	SUBMITT.													
			APPROVED													

S. NO. 1218
MACH. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE		NK	SUBM. & APPR. DATE		REMARKS
			SUBMITT.					
			APPROVED					
67200	COOLER, CONDENSER & CAROLIFIER	R	SUBMITT.					
			APPROVED					
67300	OIL HEATER	R	SUBMITT.		*			
			APPROVED					
69200	LIFTING GEAR	R	SUBMITT.					
			APPROVED					
69339	WELDING MACHINE	R	SUBMITT.					
			APPROVED					
69400	INCINERATOR	R	SUBMITT.					
			APPROVED					
69500	OILY WATER SEPARATOR	R	SUBMITT.					
			APPROVED					
69600	FRESH WATER GENERATOR	R	SUBMITT.					
			APPROVED					
69800	CONTROL AIR DRYER	R	SUBMITT.					
			APPROVED					
			SUBMITT.					
			APPROVED					
			SUBMITT.					
			APPROVED					
			SUBMITT.					
			APPROVED					

S. NO. 1218
MACH. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
70100	ENGINE ROOM PIPING DIAGRAM	A	SUBMITT. APPROVED	A		
77700	WATER STERILIZER	R	SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			
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			SUBMITT. APPROVED			
			SUBMITT. APPROVED			

S. NO. 1218
MACH. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT. / APPROVED			
83210	ENGINEER'S WORK SHOP ARR'T & STORE ARR'T	A	SUBMITT. / APPROVED			
84010	MACHINERY PART EQUIPMENT LIST	R	SUBMITT. / APPROVED			
84040	MACHINERY SPARE PARTS AND TOOLS LIST	L	SUBMITT. / APPROVED			
87300	ENGINE CONTROL ROOM ARR'T	A	SUBMITT. / APPROVED			
87310	ARR'T OF EM'CY GEN. ROOM	A	SUBMITT. / APPROVED	R		
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			
			SUBMITT. / APPROVED			

S. NO. 1218
ELECT. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
90320	LIST OF FINAL DRAWINGS - ELECT.	A	SUBMITT. APPROVED			
90100	ARRANGEMENT OF CABLE WAY	A	SUBMITT. APPROVED	A		
90110	CABLE WAY ON FORE & MID. PART	A	SUBMITT. APPROVED	A		
91010	ELECTRIC POWER INVESTIGATION	A	SUBMITT. APPROVED	A		
91020	SHORT CIRCUIT CURRENT	A	SUBMITT. APPROVED	A		
91040	ONBOARD TEST OF ELECTRIC PART	A	SUBMITT. APPROVED			
92010	WIRING DIAGRAM OF POWER SUPPLY	A	SUBMITT. APPROVED	A		
92030	DETAIL OF BATTERY ROOM	A	SUBMITT. APPROVED	A		
92100	GENERATOR	R	SUBMITT. APPROVED	*		
92300	BATTERY	R	SUBMITT. APPROVED			
93010	ARR'T OF ELECTRIC EQUIPMENT	A	SUBMITT. APPROVED	A		

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ELECT. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
			SUBMITT. / APPROVED			
93200	MAIN SWITCHBOARD	A	SUBMITT. / APPROVED	*		
93300	EMERGENCY SWITCHBOARD	A	SUBMITT. / APPROVED	*		
93400	BATTERY CHARGING BOARD	R	SUBMITT. / APPROVED			
93500	TRANSFORMER	R	SUBMITT. / APPROVED			
94010	WIRING DIAGRAM OF POWER EQUIPMENT	A	SUBMITT. / APPROVED	A		
94100	MOTOR	R	SUBMITT. / APPROVED			
94200	CONTROL GEAR	R	SUBMITT. / APPROVED			
95010	WIRING DIAGRAM OF LIGHTING EQUIPMENT	A	SUBMITT. / APPROVED	A		
96010	WIRING DIAGRAM OF INTER COMMUNICATION	A	SUBMITT. / APPROVED	A		
96011	WIRING DIAGRAM OF INSTRUM'T & CONTROL	A	SUBMITT. / APPROVED	A		
96150	ENGINE CONTROL CONSOLE	A	SUBMITT. / APPROVED	*		

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ELECT. PART

*** LIST OF DRAWING FOR APPROVAL ***

DWG. NO.	NAME OF DRAWINGS	OWNER	SUBM. & APPR. DATE	NK	SUBM. & APPR. DATE	REMARKS
97530	DOPPLER SPEED LOG	R	SUBMITT. APPROVED			
97700	SHAFT REVOLUTION INDICATOR	R	SUBMITT. APPROVED			
97750	RUDDER ANGLE INDICATOR	R	SUBMITT. APPROVED			
97850	GROUP PANEL IN WHEEL HOUSE	A	SUBMITT. APPROVED			
97860	CONSOLE IN WHEEL HOUSE	A	SUBMITT. APPROVED			
98010	WIRING DIAGRAM OF RADIO EQUIPMENT	A	SUBMITT. APPROVED			
98031	EXTENSION ANTENNA LINE	A	SUBMITT. APPROVED			
98100	RADIO TELEGRAPH	R	SUBMITT. APPROVED			
98210	INTERNATIONAL VHF RADIO TELEPHONE	R	SUBMITT. APPROVED			
			SUBMITT. APPROVED			
			SUBMITT. APPROVED			

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